



USAFETAC TN 76-2

# SOME ASPECTS OF ESTIMATING THE PROBABILITY OF CLOUD-FREE LINES-OF-SIGHT IN DYNAMIC SITUATIONS

by

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and

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**MARCH 1976** 



UNITED STATES AIR FORCE AIR WEATHER SERVICE (MAC)

USAF ENVIRONMENTAL TECHNICAL APPLICATIONS CENTER

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Dynamic Cloud-Free Line-of-Sight (CFLOS) problems	involve either moving points
between which the line-of-sight is to be assessed line-of-sight between two points, moving or station	nary, is to be assessed.

There are no adequate assessment techniques available for these kinds of problems. As a preliminary step toward developing the required techniques, the variables associated with certain types of dynamic CFLOS problems are examined and a computer program which models the space/time aspects of these types is

presented.

#### PREFACE

In April 1975, the Staff Meteorology Office of the Air Force Weapons Laborator (AFWL/WE), working in conjunction with the Laser Systems Analysis Branch (AFWL/PGA, began a special project, "Weather Studies." The objective of this project was to determine the potential influence of the atmosphere and its associated phenomera are various airborne applications of laser devices. As the study progressed, the autions became increasingly interested in the problem of predicting the probability of a cloud-free line-of-sight (CFLOS) between two moving points. Although techniques were available for handling CFLOS questions of a static or instantaneous nature, it became apparent that these techniques were not designed to answer the kinds of questions being raised in "Weather Studies" and that new techniques were required

The computer model presented herein is a preliminary step in developing the new techniques required to solve CFLOS questions involving a moving observer, moving observed point, and/or a time dimension. The major part of this investigation was performed by Ronald A. Nelson. The major part of the computer model was performed by Mead B. Wetherbe.

The authors gratefully acknowledge the constructive criticisms and support of their co-workers at AFWL. Thanks are due especially to Captains Steven Edelman, John King, and Carl Curatola for their valuable contributions during the development of the studies and analyses presented in this report.

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# SOME ASPECTS OF ESTIMATING THE PROBABILITY OF CLOUD-FREE LINES-OF-SIGHT IN DYNAMIC SITUATIONS

#### SECTION A - INTRODUCTION

With the introduction of optical and infrare, detection and tracking devices into the Department of Defense inventory, interest grew in developing methods for estimating the usability of such devices in the presence of clouds. One result of this interest was the development of various methods for predicting the probability of hating a cloud-free line-of-sight (CFLOS) between two points. These methods, which have been available in various forms since the 1960s, provide tools for estimating CFLOS probabilities between a stationary observer and a stationary observed point at a specified elevation angle in the presence of a given amount of intervening clouds. None of these methods (e.g., Lund and Shanklin [1], McCabe [2], and Rapp, et al [3]) was designed to address CFLOS questions when moving observers, moving observed points, or time dimensions were involved. These kinds of questions are "dynamic CFLOS questions."

Many USAF applications, actual and potential, involve the use of optical or infrared systems on aircraft. Some applications might involve an airborne system, e.g., as a detector of a stationary target on the ground. In such a case one might wish to predict the rrobability that there will be a CFIOS between the detector and the target. A typical approach to this problem is to specify the altitude at which, and the range of depression angles within which, the system might operate. Then, given the climatological frequency distribution of cloud conditions for the area over which the system is to be employed, use some technique, such as that outlined in Rapp, et al., [3], to predict the probability of having a CFLOS between the two vehicles (points). Since at any instant the two points may be considered to be stationary, the approach seems reasonable for predicting the probability of an instantaneous CFLOS. Suppose, however, that one is interested not in some "instantaneous" CFLOS, but rather in a CFLOS which lasts for some finite time, on the order of one second. Or, suppose that both the observer and target are moving and that one wishes to predict the probability of a CFLOS lasting for some finite time between the two. The approach outlined above cannot handle these dynamic problems.

The remainder of this report presents the results of the work to date on dynamic CFLOS problems and makes available the computer model which we have used to gain insight into problems of this variety. It is by no means an exhaustive dissertation but the authors hope it can serve as a departure point for others interested in dynamic CFLOS problems.

#### Discussion of the Variables

One of the most important "variables" involved in dynamic CFLOS problems is the statement of the problem. The Collowing problem is used as a basis for discussing the variables associated with dynamic CFLOS problems in general:

Assume a vehicle B will be flying at a specific altitude and velocity over a specified area. A second, faster vehicle A will be introduced at an arbitrary initial slant range, azimuth, and elevation angle. The second vehicle will move on a straight-line course (Direct Intercept Course) designed to effect a collision with the first vehicle—Given sufficiently detailed cloud information for the specified area, predict the probability that, at any time, a CFLOS will exist between the two vehicles for at least t units of time before the two vehicles reach a given slant-range separation.

The variables of the problem are as follows:

- a. The initial positions of the two vehicles.
- b. The relative speeds and paths of the vehicles.
- c. The "boundary conditions" for the time duration (At) of the CFLOS and the final separation distance before which the specified CFLOS must occur.
  - d. The cloud characteristics for the area of interest.

#### Examination of the Relative Speeds and Paths

The first step in solving dynamic CFLOS problems is to determine the paths to be followed by the vehicles. Figure 1 depicts the geometry of the situation described above.

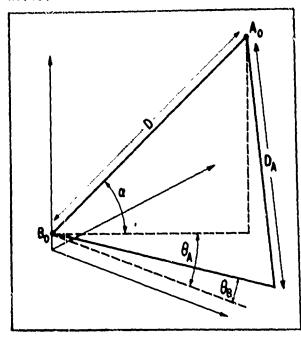


Figure 1. Geometry of the Direct Intercept Course.

 $A_{\alpha}$ ,  $B_{\alpha}$ : Initial positions of A and B

 $\theta_A$ ,  $\alpha_B$ : Initial azimuths of A and B

D: Initial slant range separating

 $D_A$ : Distance A must travel to meet

a: Elevation angle from B to A

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If  $V_A$ ,  $V_B$  represent the speeds of A and B, respectively, then the relationship of  $D_A$ , the distance A must travel to meet B, to the other parameters (see Appendix A for details) is:

$$p_{A} = p \cdot v_{2} \tag{1}$$

where

$$F_{2} = \frac{-\frac{v_{B}}{v_{A}^{2}} F_{1} \pm \left[\frac{v_{B}^{2}}{v_{A}^{2}} F_{1}^{2} + 1 - \frac{v_{B}^{2}}{v_{A}^{2}}\right]^{\frac{1}{2}}}{1 - \frac{v_{B}^{2}}{v_{A}^{2}}}$$
(2)

and

$$F_1 = \cos \alpha (\cos \theta_A + \sin \theta_A \tan \theta_B) \cos \theta_B$$
 (3)

B's total travel distance to the collision point  $(D_{\rm R})$  is directly proportional to A's and to the speed ratios involved. That is,

$$D_{\rm B} = \frac{V_{\rm B}D_{\rm A}}{V_{\rm A}} \tag{4}$$

Knowing the total distance involved, one can use direction cosines to determine the paired x,y,z positions of A and B in whatever time increments are desired. The paths, therefore, are defined.

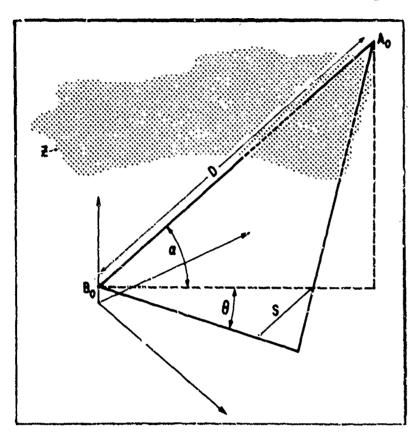
#### The Boundary Conditions for t and S

It would seem that one should now be able to specify the boundary conditions for the time duration of the CFLOS and the final separation distance of interest and using the detailed cloud information for the specified area, proceed with the CFLOS analysis. In the early stages of the study the authors proceeded in just that way, utilizing a randomly generated cloud field in the computer model as a substitute for the "detailed cloud information."

portunately, the program was written so that one could obtain a highly detailed output of the progress of the analysis. For a given set of cloud and boundary conditions, if B was repeatedly reset to its starting position and A was introduced at various azimuths, the ratio of free/obstructed lines-of-sight was almost always greater for approaches which came toward B from behind. The reason for this result will become apparent through an examination of the concept of a "critical cloud base."

#### Concept of a Critical Cloud Base

Figure 2 shows the geometry to be considered for this concept. A and B will again travel along straight lines with A following the direct intercept course.



Ao, Bo: Initial positions of A and B

D: Initial slant range separating A and B

a: Elevation angle from B to A

Relative azimuth between  $A_O$  and  $B_O$ ,  $(\theta = |\theta_A - \theta_B|)$ 

Z : Cloud base height

Figure 2. Geometry of the Critical Cloud Pase.

Consider the following problem:

For the initial conditions specified (i.e.,  $V_A/V_B$ , D,  $\alpha$ , etc.), determine that height above the plane of B, ( $Z_C$ ), above which the existence of clouds will have no effect on the probability of having a CFLOS for At units of time at least once before A and B approach within S of each other.

The detailed development given in Appendix B shows that

$$Z_{C} = Z - Z_{B} = \sin \alpha \left( s + At \frac{V_{A}}{F_{C}} \right)$$
 (5)

where  $Z_{\rm C}$  is a critical relative cloud height in that if all clouds are based at  $Z>Z_{\rm C}+Z_{\rm B}$ , the required CFLOS will occur at least once. Equation (5) shows that one should not specify cloud characteristics for any model situation without considering the "boundary conditions" and dynamics of the situation.

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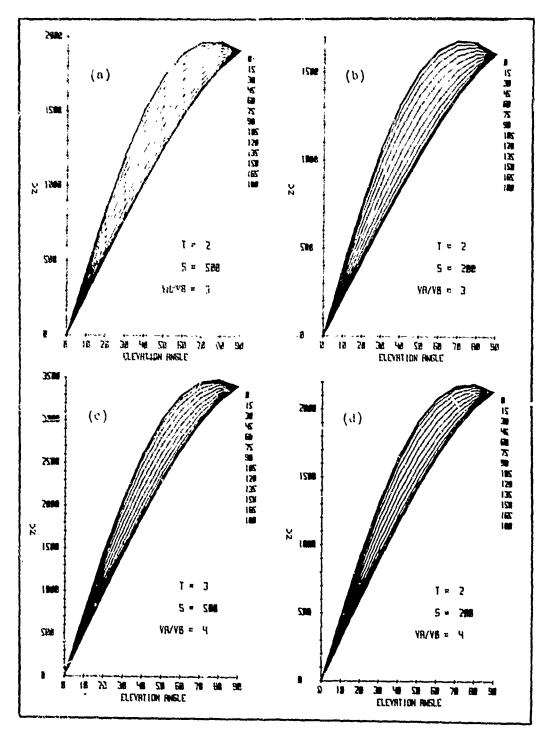


Figure 3. Variation of  $z_{c}$  with Elevation Angle.

Figures 3 and 4 depict various ways of showing the functional relationships established in Equation (5). The V<sub>B</sub> is 250 m/sec for all cases. The curves in Figure 3 are lines of constant relative azimuth; those in Figure 4 are lines of constant elevation angle. Figure 3(a), for example, shows that cloud bases at 1000 meters will insure at least one CFLOS lasting for 2 seconds (T). This CFLOS will occur before a slant-range distance (S) of 500 meters is reached by two vehicles

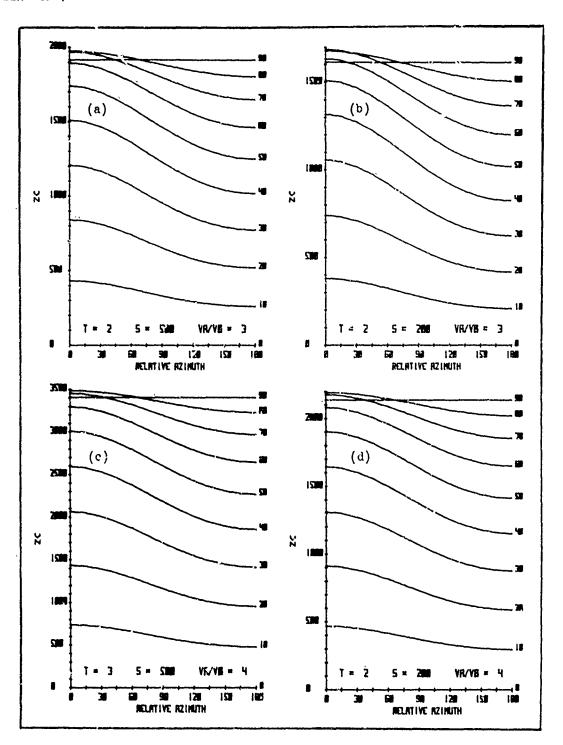


Figure 4. Variation of  $Z_{C}$  with Relative Azimuth.

travelling at a speed ratio  $(V_A/V_B)$  of 3 to 1, for all elevation angles less than about 24° at any relative azimuth. Similarly, 2000-meter cloud bases, for the conditions specified on Figure 3(d) will insure the required CFLOS for an elevation angle of 70° for relative azimuths of approximately  $105^{\circ} \le \theta \le 180^{\circ}$ . Note that the 0-180° relative azimuths can be "mirrored" into the  $180^{\circ}$ -260° azimuth range and that

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"elevation angle" could as easily be interpreted as depression angle. As a result,  $\mathbf{Z}_{\mathbf{C}}$  can be treated as a cloud separation distance and therefore could be applied to cloud tops.

Figures 4(a) through 4(d) depict the variation of  $Z_{\rm C}$  as a function of initial relative azimuth and elevation angle for various boundary conditions. The value of  $Z_{\rm C}$  generally increases with increasing elevation angle and .s higher for frontal than for rearward approaches. Note, however, that this generalization breaks down when the approach combines large elevation angles and small relative azimuths.

These variations should have a direct bearing on how one compiles the statistics in any modeled situation for a given cloud base. If, for example, the CFLOS probability statistics associated with a given elevation angle were grouped into a single value for all azimuths, that value would implicitly be weighted by the higher values associated with the rearward approaches. On the other hand, grouping the statistics at a given azimuth for all elevation angles would implicitly weight the answer by the higher values associated with the lower elevation angles. The physical reasons are apparent:

- a. For a given elevation angle the closure rate is lower for large relative azimuths.
- b. For a given azimuth the closure rate is lower for high elevation angles. In either case the time available for CFLOS is higher for lower closure rates and therefore the probability of obtaining the CFLOS is higher (i.e., there is more opportunity).

#### The Cloud Characteristics

Simple logic dictates that there is a direct relationship between the probability of having a CFLOS and the probability of having those cloud conditions which preclude having a CFLOS. Predicting the probability of having a CFLOS, therefore, requires having "sufficiently detailed cloud information." This information must be merged with the other factors, e.g., dynamics and boundary conditions, involved in the problem.

For the problem being discussed, "cloud-base" is part of the required information. This report will show that information regarding the amount of sky covered at a particular altitude and the 3-dimensional geometry and spatial distribution of the individual elements will also be required. What is yet uncertain is the practical meaning of "sufficiently detailed" information and if, and how, that meaning changes as the problem variables change.

Historical records of surface-based weather observations can be used to obtain information regarding the probability that a particular sky coverage will be experienced at a particular altitude; the detail available, however, varies inversely with the altitude. Satellite data may eventually be useful in adding more detail at higher altitudes, but currently the information is limited to the lowest 8000 feet. Little or no information, and no information, and no historical records exist

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relative to the "individual element" characteristics. Therefore, one must model the individual element characteristics and use historical data bases to obtain the sky cover.

The authors have yet to determine how best to utilize historical data since the sensitivity of answers to relatively unknown cloud-field characteristics, such as the distribution and 3-D geometry of the individual elements, are unknown. How will the interrelationship of cloud base and cloud cover as they relate to the dynamics of the problem, affect the answers? These are specific areas in which further analysis is required.

#### SECTION C - A DYNAMIC CFLOS COMPUTER PROGRAM

The computer program presented in Appendix D models a situation in which two points are separated in space in the presence of a cloud field to help study dynamic CFLOS problems. The lower point B begins moving from its initial position at a fixed heading and speed. The higher point A is introduced at a given vertical separation and slant range and a preselected azimuth to the right of B's path. Point A follows some path, usually the direct intercept course, and the line-of-sight between A and B is examined each 0.2 seconds of simulated time until a previously determined slant range is reached. B is then reset to its original position and the same process is repeated except that A approaches from the preselected azimuth to the left of B's path. B is then reset to its original position, a new heading is established 30° to the left of the original heading and the process starts anew. The scenario is repeated until a total of 12 headings (360°) have been examined. The "statistics" are then summarized for the 24 approaches involved.

#### Some Limitations/Weaknesses of the Program:

a. CLDNO, one of the two cloud models, represents a mid-continental, uniform-surface area, early-afternoon, summertime situation. This situation is relatively simple to model. CLDNO produces uniform circular elements, the centers of which are placed randomly in the X,Y plane. Coverage is determined by the X,Y projection of the individual elements onto the plane. The base height and thickness can be set but are uniform for all elements.

The random placement of the elements limits the total coverage in the application of the model. Theoretically, one could, by careful packing, achieve a coverage of about 78% (see Appendix C). In running the program, a practical limit is reached at about 45%. The program CLDOVR, developed because of this practical limit, allows for some restricted overlap of individual elements and seems to have a practical limit in coverage of about 70%. With larger fractional coverages the physical model more nearly represents a late afternoon situation but, because of the common tops used, is less than an adequate model. Modification of the model will continue to overcome the "coverage," "uniform top," and "single layer" limitations/weaknesses.

b. The coverage produced is not "sky-coverage" but rather "earth-coverage."
The former requires a projection of the cloud elements against the celestial dome.

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while the latter is obtained by projecting the cloud bases against the assumed flat, underlying surface.

- c. The chase models are limited in their applicability. For example, one would not use either model to simulate a "dog fight." Both models currently require that A be moving faster than B.
- d. The assessment of the line-of-sight takes place every 0.2 seconds of simulated time. This time-step may be inappropriate for some applications (see Appendix B).

#### Questions Addressed by the Program

Given a particular set of conditions, the program is designed to answer three questions:

- Question 1. What is the probability of having a CFLOS "at any instant?"

  The line-of-sight between A and B is examined at each A,B position until A and B approach within S of each other. The number of times the line-of-sight is free of clouds (successes) is divided by the number of times it is examined (attempts). The results are accumulated for each of the 12 headings followed by B and printed out as the "static case" shown in Figure 5.
- Question 2. What is the probability of having a CFLOS which lasts for at least t-units of time at any time?

A time, t, is chosen as an integral multiple of 0.2 seconds. That is, t=0.2N, where N-1,2,3,...M.\* The first N-consecutive lines-of-sight are then examined for a continuous CFLOS. A record is made of the results of that examination. The first line-of-sight is then ignored and the next N-consecutive lines-of-sight are examined, etc. The number of times that N-consecutive lines-of-sight are cloud free divided by the number of times N-consecutive lines-of-sight are examined before S is reached, forms the basis for the answer to this question. The process is repeated for all B-headings and the collected statistics show up as "Probability of a CFLOS for the time indicated," with t, in seconds, following ".GE." in Figure 5.

Question 3. What is the minimum frequency of occurrence of a CFLOS lasting for at least t-units of time?

For each initial placement of A,B, a binary record is made of whether or not a CFLOS existed for t-units of time at least once. For any initial set of conditions and for a given cloud situation the maximum number of attempts would be 24; i.e., A approaches B from left and right aspects for each of 12 different headings used by B. During each chase, a CFLOS either did or did not exist at least once for t-units of time.

<sup>\*</sup> For the limit of M, see Appendix B.

The output of this analysis is found in the Minimum frequency..." section of Figure 5.

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PROBABILITY OF A' CFLOG - STATIC CASE- .247
PROBABILITY OF A CFLOR FOR AT LEAST THE TIME INDICATED
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                      .KF.2
         .080
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                 6/24
                             THO SECONDS
                                                 1/24
AROVE INFO BASED ON - BASE = 5.5.TOPS = 11.5 .RADTUS = 4.0 .COVERAGE =
                                                                              .435
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PROBABILITY OF A CFLOR - STATTO CASE.
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                                                          3.0 .COVERAGE =
PROMARILITY OF A CFLOS - STATIC CASE-
                                          .278
PROBABILITY OF A CFLOS FOR AT LEAST THE TIME INDICATED
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 MINIMUM FREQUENCY OF ACCURRENCE OF A CELOS FOR AT LEAST THE TIME INDICATED
ONE SECOND
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                              TWO SECONDS
                                                 2/24
 AROVE INFO BASED ON - RASE =
                              4.0.TOPS = 11.5 .RADIUS = 3.0 .COVERAGE =
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#### Some Model Results

Figures 6a and 6b show scaled drawings of one quadrant of a cloud field generated by CLOUDNO. The light dashed lines represent B's path, which is actually at a height which is below the cloud base. The heavy dashed lines are the projections of A's path into the plane of B. The heavy solid lines are the actual paths followed by A. See Appendix D for a brief description of the HUNT and HUNTD chase models. In effect then, Figures 6a and 6b are pictures of a "run." The lines-of-sight which are examined are those lines which would connect the positions of A and B at any time.

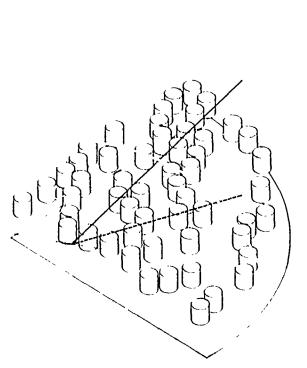


Figure 6a. A Visual Representation of CLOUDNO and HUNTD.

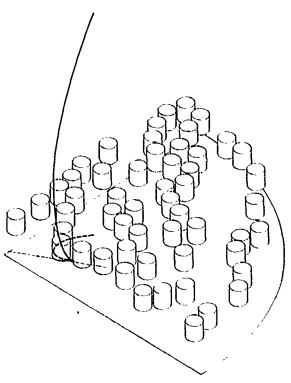


Figure 6b. A Visual Representation of CIOUDNO and HUNT.

Table 1 presents the statistics associated with many such runs. The three sets of statistics presented in the table are related to those questions discussed in the previous section. For a given run there are approximately 600 "instantaneous-attempts" and 450-550 one-second "dynamic-attempts." The "minimum frequency" values cannot exceed 24 since there are only 24 opportunities per run for having a CFLOS for the time span indicated at least once. There is, of course, only one value of "earth-cover" for a given run.

The two sets of statistics associated with A and E were derived from the same 22 nonoverlapping cloud distributions. The distributions were established based on a 400-meter cloud radius. Since the cloud elements do not overlap, one could simply change the radius and calculate the new coverage. Most of the data associated with the B and F statistics are derived from these same distributions by simply changing the thickness of the cloud elements. About one-half of the C and D statistics use

Cloud-Free Line-of-Sight Results  $V_{\rm A}/V_{\rm B}=\mu$ ,  $V_{\rm B}=250$  m/sec, S = 501 meters,  $Z_{\rm B}=150$  meters, and  $\sigma$  = 22°. CFLOS Probabilities for Various Modeled Cloud Situations when Table 1.

ccurrence/Run	၁ခ	Range	9-0	<b>ት-</b> 0	23-24	2-5	4-10	8-1
Min. Frequency of Occurrence/Run	t = 1 sec	I×	9.9	2.1	23.9	3.5	7.8	6.7
	sec	S <sub>X</sub>	.03	8.	.03	.02	.07	, O4
(Dynamic)	t > 1 sec	i×	70.	.02	.18	.03	.18	דר.
	aneous)	Sx	70.	.03	.02	.03	90.	,04
ŕ	Instantaneous	l×	.15	.13	.41	.21	.32	.25
	Cover	Sx.	.02	.02	.02	.02	.01	.01
	Earth Cover	۱×	L#.	877.	87.	.48	.27	.27
	meters)	Radius	7,00	007	7,00	700	300	300
	Cloud Data (meters	Тор	900	1400	1900	1600	900	1400
	Cloud	Base	700	700	300	550	400	700
	;	No. of Runs	22	18	10	ω	25	13
		Case	Æ	W	ပ	A	{z}	Ft.

where 
$$\overline{x} = \frac{1}{11} \sum_{i=1}^{11} x_i^2$$
 and  $Sx = \begin{vmatrix} \frac{1i}{2} & x_2^2 & 11 & \frac{7}{2} \\ \frac{1-1}{11-1} & \frac{1}{11-1} & \frac{1}{11-1} \end{vmatrix}$ 

Range:  $x_1$  minimum value to  $x_1$  maximum value

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these distributions, so there are, at most, 30 different cloud element distributions; certainly not a representative sample of the infinite variety of distributions which could be produced either in the real world or in the model. Nonetheless, Table 1 can be used to gain insight into dynamic CFLOS problems.

The content of Table 1 is associated with a very specific set of parameters; i.e., specific values for  $V_B$ ,  $Z_B$ ,  $V_A/V_B$ , S, and  $\alpha$ . The authors wish to stress the point: Dynamic CFLOS problems tend to be complex and unique and it will be difficult to generalize solutions for large ranges of the associated parameters.

The "Earth-Cover" for Cases A, B, C, and D are essentially the same. Examination of the associated "instantaneous" and "dynamic" probabilities indicates that the values may be more sensitive to changes in cloud-base height than to changes in cloud thickness. This sensitivity relationship is even more evident in the "Minimum Thickness.." data. Comparing E and F to C leads to the tentative conclusion that, at least for some combinations of decreased-coverage/increased-cloud-base, the latter will be the more significant. Finally, the probability of having a finite-time CFLOS is less than the probability of having a CFLOS instantaneously. This follows from the fact that a low instantaneous value indicates a frequently obscured line-of-sight.

Experience indicates that the distribution of the individual elements is a significant variable and that its significance increases as earth-coverage decreases. This seems to be particularly true for earth-coverage less than about 40%. The authors also tend to believe that, for a given coverage, "cloud radius" is not a significant variable; although the elements are smaller, they are more numerous and the increased population effectively cancels the effect of the decreased size.

Changes in  $V_A/V_B$  are significant, as can be seen by a comparison of Table 1 and Table 2. The same specific parameters are used for both tables except that, in Table 2,  $V_A/V_B = 3$ , and 10 completely different distributions were used. Case 1 of Table 2 and Case A of Table 1 differ only slightly in mean earth-coverage and may be compared directly. Being cautious to note the differences in cloud characteristics, one may also compare Case 2 to Cases C and D, and Case 3 to Cases E and F. The generally higher values of Table 2 would seem to stem primarily from the lower speed ratios; but one must be cautious of such a generalization.

Table 2. CFLOS Probabilities for Various Modeled Cloud Situations when  $V_A/V_B=3$ ,  $V_B=250$  m/sec, S=501 meters,  $Z_B=150$  meters, and e  $\approx 22^{\circ}$ .

						CELOS Resu	Its
	c	Loud D	ata	Mean	Pr (Instan-	Pr (!www.ntc)	Min. Freq.
Case	Base	T vp	Radius		taneous)	1 > 1	t = 1
1	400	900	400	, 44	.19	.08	5.1
2	700	1450	400	, 44	.37	.13	24
3	400	1150	400	,26	,50	.16	11

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Table 3 presents selected calculations of  $Z_{\rm C}$  which can be used to help interpret the statistics of Tables 1 and 2. (Linear interpolation of the values will be accurate to within about 1%.) For the conditions in Table 1,  $Z_{\rm C} \simeq 548$  meters. Since  $Z_{\rm B}$  for Tables 1 and 2 was 150 meters, any cloud base above 698 meters for Table 2, or above 795 meters for Table 1, would assure a CFLOS for one-second at least once. Therefore, the minimum frequency values of Case C and Case 2 are essentially predictable a priori. Note also that if A approaches B from behind with a relative azimuth of  $167^{\circ}$   $V_{\rm A}/V_{\rm B} = 3$ ,  $\alpha \leq 20^{\circ}$ , the minimum frequency column of Case D could be "predicted" (i.e., calculated) a priori.

Table 3.  $Z_C$  Values for Selected Conditions  $V_B = 250$  m/sec, t = 1 sec, S = 501 meters.

Speed Ratio:  $V_A/V_B = 3$  Speed Ratio:  $V_A/V_B = 4$ 

D3 'a ca					Initial Relative Azimuth							
Elev. Angle	15°	30°	45°	165°	150°	135°	15°	30°	45°	165°	150°	135°
10°	258	252	5/1/1	175	178	183	301	296	288	219	555	227
50°	503	492	476	347	353	363	589	579	564	14314	440	450
30°	723	710	688	514	522	535	850	837	817	641	649	664

#### SECTION D - SUMMARY AND CONCLUSIONS

Current techniques for predicting the probability of a CFLOS are designed for problems which are instantaneous in nature and involve stationary points. Dynamic CFLOS problems involve either the movement of one, or both, of the points b tween which the line-of-sight is to be assessed or a time during which the line-of-sight is to be assessed, or both movement and time may be involved. Hence, current CFLOS prediction techniques can not be used for dynamic CFLOS problems. To assess the potential usability of those airborne electro-optical systems which are effectively blocked by clouds, new techniques must be developed. "Modeling" is the approach which the authors have used as a preliminary step in that direction.

The computer program discussed herein indicates that dynamic CFLOS problems tend to be complex, unique, and not amenable to generalization. To solve a dynamic CFLOS problem one requires a detailed knowledge of the initial positions and subsequent velocities of the two points between which the line-of-sight is to be assessed, detailed knowledge of the boundary conditions related to the space/time dimensions of the problem, and detailed knowledge of the cloud field characteristics, including the 3-dimensional geometry and spatial distribution of the individual cloud elements. The dynamics of a problem might be definable through a knowledge of the operational characteristics of the aircraft involved. The boundary conditions and time increments to be used in the line-of-sight assessment might stem from the characteristics of the electro-optical system. These are, essentially, nonmeteorological problems. The meteorologist will have to define the cloud field characteristics.

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Practically speaking, extensive knowledge of the required cloud field characteristics is limited to "cloud amount vs altitude" and even that is limited, essentially,
to the lowest 8000 feet. Satellite data may be useful in extending our knowledge of
this parameter at higher altitudes. Detailed information relative to the geometry
and spatial distribution of the individual elements is extremely limited to nonexistent. To determine what degree of resolution will be required and how much intelligence can be derived from historical records will require further insight into the
nature of dynamic CFLOS problems and further analysis of the data base.

The computer program presented herein can be a useful tool in developing insight into the variables associated with dynamic CFLOS problems. In particular, it can be used to examine the sensitivity of the answers to changes in the input parameters. Being careful to observe the artificiality of the model, it can also be used to obtain what might best be termed "bell-park" estimates of real world situations. For example, for situations similar to those discussed in this report, it would seem that the probability of having a cloud-free line-of-sight, either instantaneously or for as short a period as one second, will be low even in fair-weather conditions.

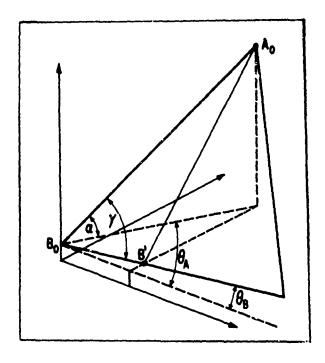
#### SECTION E - REFERENCES

- [1] Lund, I. A. and Shanklin, M. D.: "Universal Methods for Estimating Probabilities of Cloud-Free Lines-of-Sight Through the Atmosphere," <u>J. Appl. Meteorol.</u>, Vol. 12, 1973, pp. 28-38.
- [2] McCabe, J. T.: "Estimating Mean Cloud and Climatological Probability of Cloud-Free Line-of-Sight," AWSTR 186, Air Weather Service, Scott AFB, IL., 1965, 26 p.
- [3] Rapp, R. R., et al.: "Cloud-Free Line-of-Sight Calculations," J. Appl. Meteorol., Vol. 12, 1973, pp. 484-493.

#### Appendix A

#### DIRECT INTERCEPT MODEL

<u>Problem:</u> Given the initial positions and speeds of A and B and a level route of flight at known azimuth for B, find the distance A must travel to intercept B.



 $A_0$ ,  $B_0$  = Initial positions of A and B

 $\alpha$  = Elevation angle from  $B_0$  to  $A_0$ 

 $\theta_B$  = Azimuth of the path to be traversed by B

 $\theta_A$  = Azimuth of  $A_0$ 

 $v = Angle between <math>\overline{A_0B_0}$  and  $\overline{B_0B^1}$ 

Figure A-1. Direct Intercept Model.

Let the following definitions apply:

 $(X_A, Y_A, Z_A)$ , (0, 0,  $Z_B$ ): x, y, z coordinates of  $A_O$  and  $B_O$ 

C : Distance A<sub>O</sub>B'

D: Distance  $\overline{A_0B_0}$ 

 $\mathbf{D}_{\mathbf{A}}$ ,  $\mathbf{D}_{\mathbf{B}}$ : Distance to be traveled by A and B

 ${\bf V}_{\bf A}$ ,  ${\bf V}_{\bf B}$ : Constant speeds of A and B

Begin by solving for Cos y. From Figure A-1 and the definitions given,

$$Y_A = D \cos \alpha \sin \theta_A$$
 (A-1)

$$X_A = D \cos \alpha \cos \alpha_A$$
 (A-2)

$$\overline{B_0}B^{\dagger} = X_A \operatorname{Sec} \theta_B \tag{A-3}$$

From the law of cosines we have:

$$c^2 = p^2 + (\overline{B_0 B^T})^2 - 2p (\overline{B_0 B^T}) \cos \gamma$$

and, substituting from Equation (A-3)

$$c^2 = D^2 + x_A^2 \sec^2 \theta_B - 2Dx_A \sec \theta_B \cos \gamma \qquad (A-4)$$

But, note that

$$c^2 = (z_A - z_B)^2 + (y_A - x_A \tan \theta_B)^2$$
 (A-5)

Hence, one can set Equation (A-4) equal to Equation (A-5), carry out the multiplication indicated in the second term of the right side of Equation (A-5), and rearrange and combine terms to obtain

$$\cos \gamma = \frac{X_A + Y_A \tan \theta_B}{D \sec \theta_B}$$
 (A-6)

Substituting Equations (A-1) and (A-2) for  $Y_A$  and  $X_A$ , respectively, and rearranging and simplifying terms results in the equation

$$\cos \gamma = \cos \alpha \left( \cos \theta_A + \sin \theta_A \tan \theta_B \right) \cos \theta_B \tag{A-7}$$

which will be generalized for use as

$$Cos y = F_1 (A-8)$$

By definition,  $D_A = V_A t$  and  $D_B = V_B t$ . Therefore,

$$D_{B} = D_{A} \frac{V_{B}}{V_{A}} \tag{A-9}$$

From the law of cosines we have:

$$p_A^2 = p^2 + p_B^2 - 2pp_B \cos y$$
 (A-10)

Substituting from Equations (A-8) and (A-9) and rearranging terms

$$D_A^2 \left(1 - \frac{V_B^2}{V_A^2}\right) + 2D_A D_A \frac{V_B}{V_A} F_1 - D_2 = 0$$
 (A-11)

from which, using the general solution to quadratic equations, and requiring that  $V_{\rm B} \neq V_{\rm A}$ ,

$$D_{A} = D \left[ -\frac{V_{B}}{V_{A}} F_{1} \pm \sqrt{\frac{V_{B}^{2}}{V_{B}^{2}} F_{1}^{2} + 1 - \frac{V_{B}^{2}}{V_{A}^{2}}}}{1 - \frac{V_{B}^{2}}{V_{A}^{2}}} \right]$$
(A-12)

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or, for  $V_B = V_A$ 

$$D_{A} = \frac{D}{2F_{1}} \tag{A-13}$$

and, physically, only the positive radical of Equation (A-12) applies.

In the text the problem was stated assuming  $V_A > V_B$ . The computer program currently requires that  $V_A$  be greater than  $V_B$ . However, Equations (A-12) and (A-13) clearly indicate that  $D_A$  has solutions which are not restricted by  $V_A > V_B$ . Three possibilities will be examined:  $V_A = V_B$ ,  $V_A > V_B$ , and  $V_A < V_B$ .

# <u>Case 1</u>: $V_A = V_B$

from Equation (A-8), the range of  $F_1$  is:  $-1 \le F_1 \le 1$ . Physical reasoning dictates that  $F_1 \le 0$  be eliminated since A cannot overtake B when approaching from behind B's initial position. Therefore, only  $0 \le F_1 \le 1$  is considered.

From Equation (A-13) and the definition of  $F_1$ 

$$\frac{D}{D_A} = 2 \cos \gamma \tag{A-14}$$

from which solutions may be obtained when  $V_A=V_B$  for all choices of  $\gamma$  such that  $\frac{3\pi}{2}<\gamma<\frac{\pi}{2}$  .

Now examining  $\frac{V_B}{V_A}$  = K where K  $\neq$  1 and using Equation (A-12), we obtain

$$D_{A} = D \left[ \frac{-KF_{1} \pm \sqrt{K^{2} (F_{1}^{2} - 1) + 1}}{1 - K^{2}} \right]$$
 (A-15)

Given that  $K \neq 1$ , Equation (A-15) only requires that

$$K^2 (F_1^2 - 1) \ge -1$$
 (A-16)

Clearly any negative contribution must come from  $F_1^2$  - 1. This dictates that  $K^2$  must be restricted to certain maximum values to insure that the condition of Equation (A-16) is not violated. Table A-1 and Figure A-2 illustrate the values as a function of  $\gamma$  for the range  $0 \le \gamma < 90^\circ$ .

Tables A-1. Maximum K-Values.

$$\kappa_{\text{MAX}}$$
  $\sim$  5.75 2.92 2.00 1.56 1.31 1.15 1.06 1.02  $\gamma$  0 10 20 30 40 50 60 70 80

Case 2: VA > VB

For this case K < 1 and therefore the condition imposed by Equation (A-16) is always met.

Case 3:  $V_A < V_B$ 

For this case K > 1 and therefore K must be restricted to the range  $1 < K < K_{max}$ 

Finally,

$$D_{A} = DF_{2} \qquad (A-17)$$

where  $F_2$  is defined according to the following:

Case 1: 
$$F_2 = \frac{1}{2F_1}$$
 when  $V_A = V_B$ 

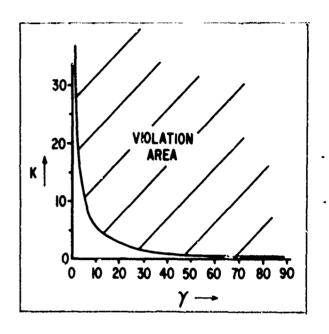


Figure A-2. Violation Area for K and Y.

Case 2:

$$F_{2} = \frac{-\frac{V_{B}}{V_{A}} F_{1} + \sqrt{\frac{V_{B}^{2}}{V_{A}^{2}} F_{1}^{2} + 1 - \frac{V_{B}^{2}}{V_{A}^{2}}}}{1 - \frac{V_{B}^{2}}{V_{A}^{2}}} \quad \text{when } V_{A} > V_{B}$$

Case 3:

$$F_2 = \frac{-KF_1 + \sqrt{K^2 (F_1^2 - 1) + 1}}{1 - K^2}$$

subject to both of the following conditions:

a. 
$$K^2 (F_1^2 - 1) \ge -1$$

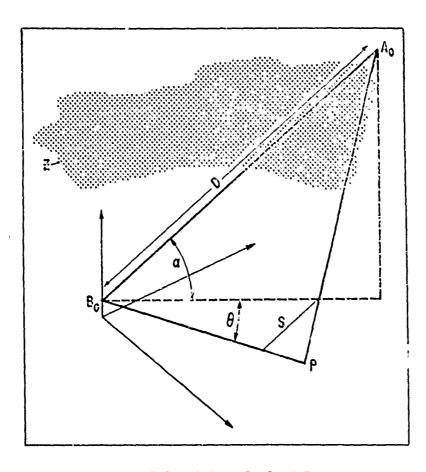
b. K > 1

Note that Case 2 is the case discussed in the text.

#### Appendix B

#### ANALYSIS OF THE CRITICAL RELATIVE CLOUD BASE

Problem: Determine the height, Z<sub>C</sub>, above the plane of B, above which the existence of clouds will have no effect on the probability of having a CFLOS between A and B for At units of time at least once before A and B approach within distance S of each other, given that A pursues B in accordance with the direct intercept model.



- Azimuthal separation of A<sub>O</sub> and B<sub>O</sub> (relative azimuth)
- $\alpha$ : Elevation angle from  $B_o$  to  $A_o$
- D: Distance A<sub>o</sub>B<sub>o</sub>
- Z: Base height of the lowest layer of clouds
- P: Intersection of the paths of A and B

Figure B-1. Critical Cloud Base.

Let the following definitions apply:

 $A_o$ ,  $B_o$ ,  $D_h$ ,  $D_B$ ,  $Z_A$ ,  $Z_B$ : As defined in Appendix A

 $\pmb{\delta}$  : Angle between  $\overline{\textbf{A}_{\textbf{O}}\textbf{P}}$  and  $\overline{\textbf{Z}_{\textbf{A}}\textbf{Z}_{\textbf{B}}}$ 

 $L_C$ : Distance from  $A_o$  to Z along the path of A

L: Distance from the intersection of A's path with the plane of Z to that point where A and B come within distance S of each other

LS, LS: Distances which have yet to be traveled by A and B from that point where A and B are within distance S of each other to the point P.

Noting from the definitions that:

$$D_{A} = L_{C} + L_{S}^{A} + L$$

and therefore

$$\frac{L}{V_A} = \frac{D_A - L_C - L_S^A}{V_A} \tag{B-1}$$

and

$$\cos \delta = \frac{Z_A - Z}{L_C} = \frac{Z_A - Z_B}{D_A}$$

from which

$$L_{C} = D_{A} \left( \frac{Z_{A} - Z_{B}}{Z_{A} - Z_{B}} \right) \tag{B-2}$$

From similar triangles

$$L_{S}^{A} = \frac{S D_{A}}{D}$$
 (B-3)

By definition, At =  $\frac{L}{V_A}$ . Combining this with Equations (B-1), (B-2), and (B-3), we obtain:

$$\Delta t = \frac{D_A}{V_A} \left( 1 - \frac{Z_A - Z}{Z_A - Z_B} - \frac{S}{D} \right)$$

from which

$$z = z_{B} + (z_{A} - z_{B}) \left( \frac{S}{D} + \frac{\Delta t V_{A}}{D_{A}} \right)$$
 (B-4)

Hence the cloud base relative to the height of B is

$$z_{C} = z - z_{B} = (z_{A} - z_{B}) \left(\frac{S}{D} + \frac{\Delta t V_{A}}{D_{\Delta}}\right)$$
 (B-5)

Substituting from Equation (A-17), Appendix A, for  $D_A$  yields

$$z_{c} = (z_{A} - z_{B}) \left(\frac{s}{D} + \frac{htV_{A}}{DF_{2}}\right)$$

and, since  $(Z_A - Z_B) = D \sin \alpha$ 

$$Z_{C} = \sin \alpha \left( s + \frac{\Delta t V_{A}}{F_{O}} \right)$$
 (B-6)

Hence, given  $V_A$  and the definition of  $F_2$  (see Appendix A), one can choose a slant range (S) and At of interest and calculate the height above which cloud bases will have no impact on the probability of having a CFLOS between A and B at least once before A and B approach within S of each other.



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Clearly, At will not be meaningful unless it is chosen such that

$$\Delta t \leq \frac{D_A}{V_A}$$

and therefore

$$\Delta t \leq \frac{DF_2}{V_A}$$
 (B-7)

In the analysis procedure described in the text At in treated as

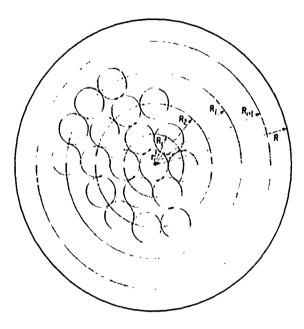
$$\Delta t = gN$$

where g is the incremental time-step used in the analysis of the line-of-sight and N has a maximum value of M such that the total time involved in the chase is not exceeded. Clearly, g only makes sense when it is some fraction of At, but what fraction should it be? A value of 0.2 seconds was chosen for the program based on a subjective analysis of the interrelationship of the cloud characteristics (radius and thickness) and the speeds typically involved. The authors have not yet examined the sensitivity of the results to changes in "g-values" but this, too, is an area which needs study. In any case, one should not choose g completely arbitrarily.

#### Appendix C

#### CLOUD-COVER LIMITATION OF A UNIFORM DISTRIBUTION MODEL

Problem: Determine the maximum fractional coverage obtainable from placing uniform circular elements into the large circular area such that each element is totally contained within the larger area and no elements overlap.



r = Radius of cloud elements

R = Radius of entire area

R<sub>i</sub> = Radius of i<sup>th</sup> locus of cloud centers where

$$R_i < R_{i+1}$$

Figure C-1. A Uniform Distribution Model.

Let the following definitions apply:

L, = Circumference of i<sup>th</sup> locus

 $N_4$  = Number of elements on  $L_4$ 

N = Total number of elements

i<sub>max</sub> = Maximum number of loci

Case 1: Condition 0 <r < < R

The circumference of the 1th locus is

$$L_{i} = 2\pi R_{i} \tag{C-1}$$

The radius of the ith locus is

$$R_{i} = 2ri \tag{c-2}$$

therefore  $L_i = 4\pi ri$ 

If the number of elements on a given locus must be an integral value, then

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The maximum number of loci which can be allowed for a given cloud radius will be  $\frac{R}{2r}$ .

From Equation (C-2), we note that a hole of radius r has been left at the center of the area. Hence, if  $\frac{R}{2r}$  = K, and K is truncated to an integer, then  $i_{max}$  = k-1 and

$$N \leq 1 + \sum_{i=1}^{K-1} N_i$$

and from N; ≤ 2mi

$$N \le 1 + 5\pi \sum_{i=1}^{i=1} i$$
 (C-4)

and testing various values of K, the authors found that

$$N \le 1 + \pi K(K-1)$$
 (C-5)

The fraction of the area covered by clouds is

$$F = \frac{N\pi r^2}{\pi R^2} = \frac{Nr^2}{R^2}$$

and therefore

$$F \leq \frac{1+\pi K(K-1)}{4K^2}$$

Finally, we note

$$\lim_{k\to\infty} F = \frac{\pi}{4} \sim .7854$$

In practice, the authors have observed that randomly placed elements, which are not allowed to overlap, rarely exceed 50% coverage.

#### Case 2: 0 < r < R

The solution of r=F and N=1 with the element centered at the center of the circle is a trivial but valid solution. Another solution is  $\sqrt{\frac{n}{H}}$  R for which  $F=\frac{n}{H}$ . Hence, one can obtain fractional coverage in excess of  $\frac{n}{H}$  for a single element centered at the center of the circle whose radius meets the condition

$$R \int_{\overline{H}}^{\overline{H}} < v < R$$

#### Appendix D

#### LISTING OF A DYNAMIC CFLOS COMPUTER PROGRAM

The computer program discussed herein can be thought of in terms of two separate, but relatable, parts: Driver programs and subroutines. Driver programs are used to define the values which the variables are to have in the subroutines and to model the "evolution" of the dynamic encounters. The currently modeled evolution for all driver programs is as described in Section C of this report. Alternative models might call for a single azimuthal approach (e.g., 15° to the left of B, as a single choice), but repeated with higher resolution (e.g., reanalysis for incremental changes of 10° in B's heading). A better understanding of the overall program can be obtained by operating one of the driver programs described below.

#### Driver Programs

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- BCFLOS A basic driver program which utilizes a nonoverlapping cloud field, a direct intercept chase model and azimuthal variations of ± 25° from B's heading. Summaries are made of the line-of-sight statistics collected for the 12 headings taken by B. BCFLOS could be run with an overlapping cloud-field. (Table D-1.)
- IDSØAZ A somewhat more involved program which is to be used only with a nonoverlapping cloud-field. Reanalysis of the line-of-sight is performed as changes are introduced in cloud base, thickness, and radius values, for a given cloud-element distribution. (Table D-2.)
- LOSIAZ A program designed specifically for the overlapping cloud-field. Users will note that the only significant difference between LOSØAZ and LOSIAZ is that in the latter, the cloud-radius is not varied. (Table D-3.)

#### Subroutines

Comment cards have been inserted liberally in all subroutines. However, a brief, functional description of each subroutine appears below. An examination of the listing in Table D-4 will reveal that many "PRINT" statements have been rendered inactive by a "C" in Column 1. These statements are rarely used after familiarity is gained with the overall program. The inactive statements have been retained in the listing to provide potential users with tools which can be used to follow the detailed flow of the CFLOS analysis. Reactivation of all "PRINT" statements will produce a computer printout about 4 inches thick. If wholesale reactivation is desired, we recommend using BCFLOS as the driver program since it is set up to produce only a single cloud distribution and to "fly through" only once.

SET Initializes required values within other subroutines.

CLDNO Contains only one entry: Entry CLOUDNO. CLOUDNO establishes the positions of the centers of each cloud and a percentage coverage. The cloud center coordinates are generated using a random number generator. Cloud elements will not overlap.

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CLDOVR Contains a single entry, CLOUDNO, which allows a newly introduced element to overlap one existing element up to a limit equal to the cloud radius.

This entry should be used for coverages in excess of about 45%.

HUNTF Contains two different entries:

- a. Entry HUNT produces the positions of two moving objects (A,B) whose initial positions have been specified in the driver program. The dynamics of this entry are such as might correspond to an IR Sensor tracking a moving object. In essence, A continually heads toward the current position of B.
- b. Entry HUNTD is a slightly more sophisticated chase routine (see Appendix A) in which the point toward which A must move to intercept B is predetermined, based on the assumption that B will continue on a straightline course at a constant speed.

Output from both of these entries includes x,y,z coordinates, the slant range distance between A and B, and the elevation angle from B to A, all as a function of time. The parameters are no longer calculated after a predetermined time and/or slant range has been reached. LIMA and LIMB are used to indicate that the elevation angle has exceeded certain boundaries, in the case of LIMA, or that both vehicles are below the base of the cloud (LIMB). Although not currently used, these indicators are useful diagnostic tools.

FREEF Contains only Entry FREE. FREE uses the positional information derived from either HUNT or HUNTD to examine the line-of-sight to ascertain whether or not it intercepts any clouds. If it intercepts any cloud it is determined to be obscured; otherwise a CFLOS "hit" is recorded.

MAPF & These are the "bookkeeping" and "statistics gathering" subroutines. CATCH

### Table D-1. Listing of BCFLOS.

	PROGRAM BCFLOS%INPUT,OUTPUT<	A	1
.C	THIS_PROGRAM_WAS, DESIGNED_TO_EXAMINE_THE_TIME_HISTORY_OE_THE.CLOUD_	.A	.2.
C		A	
<u>.</u>	IN THE PRESENCE OF A CLOUD FIELD. THE USER MUST SPECIFY THE		4.
'C		A	5
<u> </u>	OF TWO CLOUD MODELS TO BE USED IN THE ANALYSIS. AFRIAL COVERAGE OF	_A	_6_
C	THE CLOUD IS DETERMINED BY THE FRACTION OF THE UNDERLYING SURFACE	A	7
(C	COVERED BY THE PROJECTION OF THE CLOUD BASES.		8.
,	COMMON /BLK1/ XCLD\$1000<.YCLD\$1000<.JJ	A	9
	_COMMON_/BLK2/_PXAT100<.PYAT100<.PZAT100<.PXBT100<.PYBT100<.PZBT100	Α.	10
_	1<,TAB\$100<,DAB\$100<,KK	Λ	
	COMMON /BLK3/ AZA.AZB.EL.XBI.YBI.ZBI.DI.YA.YB		
	COMMON /BLK4/ KLN\$200<,KL,LIMA\$4<,LIMB\$4<	A .	
	COMMON_/BLK5/_CLD8		
\$	COMMON /BLK6/ J	Α	1.6
	COMMON_ZBLK7Z_BCLD.TCLD.PCVR.RAD.HOR	A .	16
C	ESTABLISH INITIAL CONDITIONS	Α	
Č	COMPORTION INTERACTIONS OF THE THE OBJECTS		
<u>c</u>	Z # VERTICAL SEPARATION OF THE TWO OBJECTS	A	
C	DI # INITIAL SLANT RANGE DISTANCE	A	
		<b>A.</b> .	
C	OBJECT.	A	
•	XBI.YBI.ZBI. W. INITIAL POSITION OF B.		
C	VA.VB # SPEEDS OF A AND B. VA MUST BE GREATER THAN VB.	A	
		_A	
Ç	HOR # RADIUS OF REGION OVER WHICH CLOUDS ARE EMPLACED.	٨	
		A.	
С		A	
•	2#5000 <sub>4</sub> /3 <sub>6</sub> 28,	A	
	DI#4000.	A	
<b></b>	Y#Z/D1		30_
	EL#ASIN\$Y<		31
-	.EL#EL±180./3.1416.	.A.	-
	XBI#YBI#O.	A	33
	ZB1#.150。	,Α,	34.
	VA#1000.	A	35
<u> </u>		Δ	36.
•	HOR#5000.	A	37
j.	PCVR#-3.	Δ	38.
,	RAD#4.	Λ	39
d- 100	BCLD#4a	.A	40
	TCLD#9.		41
t	CALLSET	Α	42
C	DECIDE ON USING AN OVERLAPPING CLOUD FIELD *CLOUDOK OR A	A	43
£	NON-OVERLAPPING FIELD SCLOUDNOK. CLOUDO IS RECOMMENDED FOR		
C	COVERAGES OF .50 OR GREATER.		
-	CALLCLOUDNO	Ä	
	CALL CATCHI		
	CALLGILO.	Α.	
	DO 1 J#1,12		40
	AZB#30-0+XJ-1<		•
<del></del>	CALL CLR		.3u. 51
	.AZA#AZB&25.0		52
,	<b>、内た内を外に口なるシャ</b> リ	A	24

## Table D-1. Listing of BCFLOS (Cont'd).

C	DECIDE ON A DIRECT INTERCEPT THUNTDS OR TAIL CHASING THUNTS	A	53
	SCENARIO.	A_	_54_
	CALL HUNTD	A	55
	KK#KK-1		_56_
	CALL CLRX	A	57
	CALL FREE	A_	_58_
	AZA#AZB-25.0	A	59
	CALL HUNTD	A	60
	KK#KK-1	Ā	61
	CALL CLRX		62_
	CALL FREE	Δ	63
	CALL_GIL1	Â.	_64_
*******	1 CONTINUE		
	CALL_GIL2		66
	***PCVR IS RESET TO THE ACTUAL COVERAGE ATTAINED IN THE CLOUD		67
Č	SUBROUTINE SETTING COVER # POVE OBTAINS THIS VALUE FOR PRINTOUT	~	_68_
c			_69
Ĺ	PURPOSES.***		
	COVER#PCVR	_	7.0
	PRINT 2, BCLD, TCLD, RAD, COVER	A	71
C		A.	7.2.
	2 FORMAT %//,10X,29HABOVE INFO BASED ON - BASE # .F5.1,8H.TOPS # .F5	A	73
	1.1.11H .RADIUS # .F5.1.13H .COVERAGE # .F6.3<		74_
	END	A	75-

# Table D-2. Listing of LOSØAZ.

	DUGGERM A DECAMPARITY ON THE STATE OF THE ST	
Č	PROGRAM.LOSOAZXINPUT.OUTPUT< THIS PROGRAM WAS DESIGNED TO EXAMINE THE TIME HISTORY OF THE CLOUD	A 2
_		
S	IN THE PRESENCE OF A CLOUD FIELD. THE USER HUST SPECIFY THE	4
<u> </u>	INITIAL CUNDITIONS AND DECIDE UN ONE DE THO CHASE MODELS TO BE	_AŚ
Č	USED IN THE ANALYSIS. THIS PROGRAM IS TO BE USED ONLY WITH NON-	A 6
.c	. OVERLAPPING CLOUD&FIELDS.	
С	AERIAL COVERAGE OF THE CLOUD IS DETERMINED BY THE FRACTION OF THE	A 8
<b>C</b>	UNDERLYING.SURFACE. COVERED BY THE PROJECTION OF THE CLOUD BASES	.A 19:
	CUMMON /BLK1/ XCLD#1000<,YCLD#1000<,JJ	A 10
	COMMON /BLK2/ PXAR100<,PYAR100<,PZAR100<,PXBR100<,PYBR100<,PZBR100	
	1<,TAB%100<,DAB%100<,KKCUMMON /BLK3/ AZA,AZB,EL,XBI,YBI,ZBI,DI,YA,YB.	A 12
****	COMMON /BLK4/ KLN\$200<,KL,LIMA\$4<,LIMB\$4<	A 14
	COMMUN /BLK5/ CLDB	A. 15
	COMMON /BLK6/ I	A 14
	COMMON ZBLKTZ BCLD+TCLD+PCVR+RAD+HOR	ÀIŽ
, C	ESTABLISH INITIAL CONDITIONS	A 18
C	Z # VERTICAL SEPARATION OF THE TWO DBUECTS	A 19
C	DI # INITIAL SLANT RANGE DISTANCE	A 20
.C	EL # ELEVATION ANGLE FROM THE SLOWER \$B< TO THE FASTER \$A<	
· C	ORJECT.	A 22
ĽĊ.	XBI,YBI,ZBI # INITIAL POSITION OF B. VA.VB # SPEEDS OF A AND B. VA MUST BE GREATER THAN VB.	_A23.
C C	RAD # RADIUS OF CLOUD ELEMENTS DIVIDED BY 100.	A 24 A 25
_ <u></u>	HOR # RADIUS OF REGION OVER WHICH CLOUDS ARE EMPLACED.	A 26
.C		_AZZ
.c	BCLD. TCLD # BASE AND TOP OF CLOUD ELEMENTS DIVIDED BY 100.	A 28
_		_A29
	D1#4000.	A 30
	YellI	_A31,
	EL#ASIN <b>TY</b> <	A 32
	EL#EL#180./3.1416	_A33.
	XBI#YBI#O.	A 34
	ZBI#150.	
	VA#750• VB#250•	A 36 A 37
<del></del>	HOR#5000.	A 38
_	.ELAG#0	
	1 CONTINUE	A 40
	FLAGNFLAGE1	_A41,
	KKK#O	A 42
*****	PCVR4-5.	<u>-A_43</u> .
	RAD#4.	A 44
	2 CONTINUE BCLD#4.	A. 45. A 46
	TCLD#9.	
-	3 CONYINUE	A 48
	THCLD#TCLD-8CLD	A 49
	DO 6 MW1,2	A 50
.C.	CHANGE THICKNESS OF CLOUD WITHOUT CHANGING BASE OR POSITION. DE	.,A. 5.1.
С	ELEMENT. ***	A 52
	TCLD#TCLD&%M-1<*THCLD/2.	.A. 53,
	IF \$M.GT.1< GO TO 4	A 54
····	IF KKK.GT.OC GU TO 4	_A55.
r	CALL SET	A 56
	USE A NON-OVERLAPPING CLOUD FIELD ONLY. DO NOT CALL CLOUDD WITH THIS PROGRAM.	A 5.7
U	CALL CLUUDNO WITH THIS PROBRAM.	A 59
	AUP APANAM	W 21

#### Table D-2. Listing of LOSØAZ (Cont'd).



4 CONTINUE	A 60
CALL CATCH1	
CALL GILO	A 62
00,5_J#1;12	A63.
AZ8#30.0*\$J-1<	A 64
CALL CLR	A65.
AZA#AZ8625.0	A 56
C DECIDE ON A DIRECT INTERCEPT THUNTOK OR TAIL CHASING THU	INTC< A A7
C SCENARIO.	A 68
CALL HUNTD	A69_
KK#KK-1	A 70
CALL, CLRX	A71
CALL FREE	A 72
AZA#AZB-25.0	
CALL HUNTO	A 74
:KK#KK-1	Å7.5
CALL CLRX	A 76
CALL FREE	A77
CALL GIL1	A 78
5. CONTLINUE	A79_
CALL GIL2	A 80
COVER#JJ#\$RAD#130. ##2./\$HOR##2.<</td <td>A_81_</td>	A_81_
PRINT 10, BCLD, TCLD, RAD, COVER	A 82
6. CONT.INUE	A83
KKK#KKKE1	A 84
_CCHANGE BASES OF CLOUD WITHOUT CHANGING THE POSITION OF T	1:EA_85_
C ELEMENTS.	A 86
BCLD48CLD£1.5	A_87_
IF %KKK.GT.2< GD TO 7	88 A
,,GO :TO: 3	A89
C CHANGE THE RADIUS TAND THEREFORE COVERAGES WITHOUT CHANG	ING THE A 90
.C. POSITION. OF THE ELEMENTS. THIS, WORKS, ONLY WITH CLOUDNO.	A91
7 RAD#3.	A 92
	A_93_
GO TO 2	A 94
a. CONTINUE.	A95
GO TO 41,94, FLAG	A 96
9. CONTINUE	97
C	A 98
10_FORMAI_X//+10X+29HABOVE_INEO_BASED.ON - BASE # +F5-1+8H+	
1.1,11H ,RADIUS # ,F5.1,13H ,COVERAGE # ,F6.3<	A 100
	•

STATES OF THE ST

## Table D-3. Listing of LOSIAE.

THIS PROGRAM.MAS.DESIGNED TO.EXAMINE.THE.TIME.HISTORY.DE.THE.CLOUD		oboditá a oca a terranous que que	_	
C OBSTRUCTED OR CLOUD FREE LINE OF SIGHT BETWEEN TWO OBJECTS MOVING  I.N. THE PRESENCE GE.A. ZLUIDLEIELD. THE LUSER MUST. SPECIETY THE  A A  C INITIAL COMDITIONS AND DECIDE ON ONE OF TWO CHASE MODELS AND ONE  OF TWO CLOUD MODELS. TO. BE USED. IN THE ANALYSIS AERIAL. COVERAGE. OE. A. 6.  C THE CLOUD IS DETERNINED BY THE FRACTION OF THE UNDERLYING SURFACE  C COVERD BY THE PROJECTION OF THE CLOUD. BASES.  COMMON SHIL/ XCLUBIOOOC, YCL DIDOOC, PZ BETIOOC, PZ B	r	PROGRAM LOSIAZZINPUT, OUTPUTC	A	1
IN. THE PRESENCE OR A CLUUD ELERO. THE LISTS MUST SPECIET THE	Č			
C INITIAL COMDITIONS AND DECIDE ON ONE OF TWO CHASE MODELS AND OME OF THE CLOUD IS DETERNINED BY THE FRACTION OF THE UNDERLYING SURFACE A THE CLOUD IS DETERNINED BY THE FRACTION OF THE UNDERLYING SURFACE A TO COVERED BY THE PROJECTION OF THE CLOUD BASES.  C CWMON SIKI/ XCLDIODOC, VCLDIODOC, JJ (COMMON SIKI/ XCLDIODOC, VCLDIODOC, PZATIOOC, PZATIO	<u> </u>			
THE CLOUD IS DETERNINED BY THE FRACTION OF THE UNDERLYING SURFACE  COMMON SIRI/ XCLDIDOOC, YCLDIDOOC, JC.  COMMON SIRI/ XCLDIDOOC, YCLDIDOOC, JC.  (COMMON SIRI/ XCLDIDOOC, YCLDIDOOC, JC.  (COMMON SIRI/ XCLDIDOOC, YCLDIDOOC, PXBILOOC, PYBRIOOC, PY	С	INITIAL CONDITIONS AND DECIDE ON ONE OF THO CHASE MODELS AND ONE	A	5
C. COVERED BY THE PROJECTION OF. THE .CLOUD.BASES. COMMON /SBLKY, YCLDT10000 COMMON /SBLKY, YCLDT10000 COMMON /SBLKY, YCLDT10000 COMMON /SBLKY, YCLDT1000 COMMON /SBLKY, YCLDT1000 COMMON /BLKSY, YCLDT100 COMMON /BLKSY, AZA,AZB,EL,XBI,YBI,ZBI,DI,VA;VB. A 12. COMMON /BLKSY, AZA,AZB,EL,XBI,YBI,ZBI,DI,VA;VB. A 13. COMMON /BLKSY, KLRZ200 COMMON /BLKSY, CLOB. COMMON /BLKSY, CLOB. COMMON /BLKSY, CLOB. COMMON /BLKSY, CLOB. COMMON /BLKSY, BCLD,TCLD,PCVR,RAD,HOR. C 2. & VERTICAL SEPARATION OF THE .TMO.OBJECTS. A 16. C 2. & VERTICAL SEPARATION OF THE .TMO.OBJECTS. A 17. C 5. & JELTICAL SEPARATION OF THE .TMO.OBJECTS. A 18. C 08JECT. C 08JECT. C 18. \$ LEVATION AND E. FROM. THE .SLOBER XBC .IO.THE.FASTER .XC. A 20. C 08JECT. C VA,VB & SPEEDS OF A AND B. VA NUST BE GREATER THAN VB. A 22. C NAD & RADIUS OF CLOUD. ELEMENTS./100. C PCVR & PERCENT OF COVERAGE DESTRED. A 26. C BCLD,TCLD & BASE AND TOP OF CLOUD ELEMENTS/100. A 27. 285000. SRIDI YAZYSR A 30. YAZYSR A 31. ELBEL*180. A 32. ELBEL*180. A 34. YAZYSR A 37. ELBEL*180. A 37. YAZYSR A 37. ELBEL*180. A 47. CONTINUE FLAGEO. A 47. TCLDBYS. C CHANGE THICKNESS OF CLOUD WITHOUT CHANGING BASE OR POSITION OF A 57. C CHANGE THICKNESS OF CLOUD WITHOUT CHANGING BASE OR POSITION OF A 57. C CHANGE THICKNESS OF CLOUD WITHOUT CHANGING BASE OR POSITION OF A 57. C CHANGE THICKNESS	.Ç.			
COMMON / SALKI/ XCLUBIOOOC, PYATIOOC, PYATIOOC, PYBTIOOC, PYBTIOOC, PZBTIOO COMMON / SALKI/ XCLUBIOOC, PYATIOOC, PYBTIOOC, PYBTIOOC, PZBTIOO 1 CABSIOC, DABTIOOC, KK COMMON / SALKI/ XCLUB, XBI, YBI, ZBI, DI, VA; VB. COMMON / SALKI/ KLMZ2OCK, KL, LIMATAC, LIMBTAC COMMON / SALKI/ KLMZ2OCK, KL, LIMATAC, LIMBTAC COMMON / SALKI/ BCLD, TCLD, PCVR, PRAD, HOR COMMON / SALKI/ BCLD, PCVR, P	C			
COMMON / SLRZ/_PXATLOOC_PYATLOOC_PZAT	.C.			
1-1-AB\$100C,0AB\$100C,KK		COMMON PARKI ACEDETOUS, TCLUETOUS, JJ  COMMON PARKI ACEDETOUS, TCLUETOUS, JJ		
COMMON / BLK3/ ALAAZB.EL.XBI.YBI.ZBI.DI.VA.VB. A 12 COMMON / BLK5/ KLNZ2OOC, KL, LIMAZ4<, LIMBY4< COMMON / BLK5/ CLOB COMMON / BLK5/ CLOB COMMON / BLK5/ CLOB COMMON / BLK5/ CLOB COMMON / BLK5/ CLOB.TCLD.PCVR.RAD.HOR CESTABLISH INITIAL CONDITIONS A 17 C 2 & VERTICAL SEPARATION OF THE .TMOOBJECTS. A 18 C OI # .INITIAL SLANT RANGE DISTANCE C EL # ELEVATION ANGLE.FROM.THE SLOWER BG.TO.THE.FASTER.XAC C OBJECT. A 20 C VA.VB # SPEEDS OF A AND B. VA MUST BE GREATER THAN VB. A 21 C YA.VB # SPEEDS OF A AND B. VA MUST BE GREATER THAN VB. A 22 C NAO # RADIUS OF CLOUD.ELEMENTS/100. A 25 C PCVR # PERCENT OF COVERAGE.DESTRED. A 26. C BCLD.TCLO # BASE AND TOP OF CLOUD ELEMENTS/100. A 27 Z#5000_/3.28 DI#4000. A 28 DI#4000. A 28 SR#DI Y#Z/SR A 30 Y#Z/SR A 30 Y#Z/SR A 30 Y#Z/SR A 30 XBLEWBI#O. A 33 XBLEWBI#O. A 34 ZBL#150. A 34 ZBL#150. A 35 XWA#1000. A 37 XWA#50. A 36 XWA#1000. A 37 XWA#50. A 36 CVA#50. A 37 CVA#50. A 36 CVA#50. A 36 CVA#50. A 37 CVA#50. A 36 CVA#50. A 37 CVA#50. A 36 CVA#50. A 36 CVA#50. A 36 CVA#50. A 36 CVA#50. A 37 CVA#50. A 36 CVA#50. A 36 CVA#50. A 36 CVA#50. A 36 CVA#50. A 37 CVA#50. A 36 CVA#50. A				
COMMON / BLK6/ XLNZ200c, KL, LIMAT4<, LIMBT4< COMMON / BLK6/ J COMMON / B COM		COMMON /REV2/ A/A.A70.Et.vot.vot.701.nt.va.vo	•	12
COMMON BLACY J COMMON BLACY J COMMON BLACY J C C ESTABLISH INITIAL COMDITIONS C C ESTABLISH INITIAL COMDITIONS A 17 C C ESTABLISH INITIAL COMDITIONS C DI # INITIAL SLANT RANGE DISTANCE C DI # INITIAL SLANT RANGE DISTANCE C EL # ELEVATION ANGEL-FROM THE SLOWER BS. TO. THE FASTER SAC C OBJECT. C XBL-YBI_2BL # INITIAL POSITION OF R A 20 C VA,VB # SPEEDS OF A AND B. VA MUST BE GREATER THAN VB. A 21 C RAD # RADIUS OF CLOUD ELEMENTS/100. C RAD # RADIUS OF REGION OVER WHICH CLOUDS ARE EMPLACED. C PCVR # PERCENT OF COVERAGE DESTRED. C PCVR # PERCENT OF COVERAGE DESTRED. C BLOTCLO # BASE AND TOP OF CLOUD ELEMENTS/100. A 27 Z 55000_/3.28 DI#4000. A 29 SR#DI A 30 Y#Z/SR BL#ASINTY< A 31 ELBASINTY< A 32 ELBEL*180./3.1416 A 33 XUL#Y0180. A 36 VA#1500. A 36 VA#1500. A 37 Y#Z/SD. A 36 HOR#5000. A 37 Y#Z/SD. A 40 1 CONTINUE A 41 ELAGELAGEL A 42 KKK#0 A 42 KKK#0 A 45 BCLD#2.5 BCLD#6. A 46 CLD#5. BCLD#5. A 46 CCUPS. TCLD#5. A 47 TCLD#5. A 48 TCLD#5. C CHANGE THICKNESS OF CLOUD WITHOUT CHANGING BASE OR POSITION OF A 51 F KKKK.GT.OC GO TO 3 A 57 CCLD#TCLD#SCLD A 55 LELERINIS.*** TCLD#TCLD#SCLD A 55 LELERINIS.*** TCLD#TCLD#TCLD#TCLD#TCLD#TCLD#TCLD#TCLD#		COMMON /BLK4/ KLN\$200<,KL,LIMA\$4<,LIMB\$4<	A	13
COMMON BLACY J COMMON BLACY J COMMON BLACY J C C ESTABLISH INITIAL COMDITIONS C C ESTABLISH INITIAL COMDITIONS A 17 C C ESTABLISH INITIAL COMDITIONS C DI # INITIAL SLANT RANGE DISTANCE C DI # INITIAL SLANT RANGE DISTANCE C EL # ELEVATION ANGEL-FROM THE SLOWER BS. TO. THE FASTER SAC C OBJECT. C XBL-YBI_2BL # INITIAL POSITION OF R A 20 C VA,VB # SPEEDS OF A AND B. VA MUST BE GREATER THAN VB. A 21 C RAD # RADIUS OF CLOUD ELEMENTS/100. C RAD # RADIUS OF REGION OVER WHICH CLOUDS ARE EMPLACED. C PCVR # PERCENT OF COVERAGE DESTRED. C PCVR # PERCENT OF COVERAGE DESTRED. C BLOTCLO # BASE AND TOP OF CLOUD ELEMENTS/100. A 27 Z 55000_/3.28 DI#4000. A 29 SR#DI A 30 Y#Z/SR BL#ASINTY< A 31 ELBASINTY< A 32 ELBEL*180./3.1416 A 33 XUL#Y0180. A 36 VA#1500. A 36 VA#1500. A 37 Y#Z/SD. A 36 HOR#5000. A 37 Y#Z/SD. A 40 1 CONTINUE A 41 ELAGELAGEL A 42 KKK#0 A 42 KKK#0 A 45 BCLD#2.5 BCLD#6. A 46 CLD#5. BCLD#5. A 46 CCUPS. TCLD#5. A 47 TCLD#5. A 48 TCLD#5. C CHANGE THICKNESS OF CLOUD WITHOUT CHANGING BASE OR POSITION OF A 51 F KKKK.GT.OC GO TO 3 A 57 CCLD#TCLD#SCLD A 55 LELERINIS.*** TCLD#TCLD#SCLD A 55 LELERINIS.*** TCLD#TCLD#TCLD#TCLD#TCLD#TCLD#TCLD#TCLD#		-CONHON /BLK5/CLDB.	.A.	-14.
C ESTABLISH INITIAL CONDITIONS  C		CUMMUN /BEK6/ J	-∕▲	15
C				
C DI # INITIAL SLANT RANGE DISTANCE C EL # ELEVATION ANGLE.FROM.THE. SLOWER %B<.TO.THE.FASTER %A	.C	2 A VEDTICAL CEDADATION OF THE THO ON ICCTS	A	17
C BL # ELEVATION ANGLE.FROM.THE.SLOMER.#BC.IO.THE.FASTER.#AC.  OBJECT.  XBI*YBI*ZBI # INITIAL POSITION OF R.  A 21.  C VA*VB # SPEEDS OF A AND B. VA MUST BE GREATER THAN VB.  A 22.  C HOR # RADIUS OF CLOUD_LEMENTS/100.  C HOR # RADIUS OF REGION OVER WHICH CLOUDS ARE EMPLACED.  B CLO.TCLO # BASE AND TOP OF CLOUD ELEMENTS/100.  A 27.  Z#\$5000./3.28.  DI#4000.  A 29.  SR#DI  A 30.  Y#Z/SR  A 31.  ELBASINTY< A 32.  ELBEL*180./3.1416  XBI#Y01#00.  A 37.  VA#1000.  A 37.  VA#250.  A 36.  HOR#5000.  A 37.  VA#250.  A 38.  HOR#5000.  A 37.  Y#Z/SR  A 40.  1 CONTINUE  FLAG#CLAGGI  A 40.  RADIUS.  BCLO#4.  RADUS.  BCLO#4.  RADUS.  BCLO#4.  A 42.  CONTINUE  FLAG#CLAGGI  A 42.  CONTINUE  A 41.  CONTINUE  A 41.  CONTINUE  A 42.  CONTINUE  A 42.  CONTINUE  A 43.  BCLO#4.  BCLO#4.  BCLO#4.  BCLO#4.  CONTINUE  A 45.  BCLO#4.  CONTINUE  A 50.  BCLO#4.  CONTINUE  A 50.  BCLO#4.  BCLO#5.  C CHANGE THICKNESS OF CLOUD WITHOUT CHANGING BASE OR POSITION OF  A 53.  ELEMENTS.  ***  ***  ***  C CHANGE THICKNESS OF CLOUD WITHOUT CHANGING BASE OR POSITION OF  A 53.  ELEMENTS.  ***  ***  ***  C CHANGE THICKNESS OF CLOUD WITHOUT CHANGING BASE OR POSITION OF  A 53.  ELEMENTS.  ***  ***  ***  C CHANGE THICKNESS OF CLOUD WITHOUT CHANGING BASE OR POSITION OF  A 53.  ELEMENTS.  ***  ***  ***  C CHANGE THICKNESS OF CLOUD WITHOUT CHANGING BASE OR POSITION OF  A 53.  ELEMENTS.  ***  ***  ***  C CHANGE THICKNESS OF CLOUD WITHOUT CHANGING BASE OR POSITION OF  A 53.  ELEMENTS.  ***  ***  ***  C CHANGE THICKNESS OF CLOUD WITHOUT CHANGING BASE OR POSITION OF  A 53.  ELEMENTS.  ***  ***  ***  C CHANGE THICKNESS OF CLOUD WITHOUT CHANGING BASE OR POSITION OF  A 53.  ELEMENTS.  ***  ***  ***  C DECO DECON USING AN OVERLAPPING CLOUD FIELD **  CLOUD OR  A 59.  **  **  **  **  **  **  **  **  **	.c	INT # INITIAL CLANT DANCE DICTANCE		10
C OBJECT. C XBI_YBI_ZBI_# INITIAL_POSITION_OF R. A 21. C YA,VB # SPEEDS OF A AND B. VA MUST BE GREATER THAN VB. A 23. C RAD.# RADIUS OF CLOUD_ELEMENTS/100. A 26. C HOR # RADIUS OF REGION OVER WHICH CLOUDS ARE EMPLACED. A 25. C PCVR # PERCENT. OF COVERAGE_DESTRED. BCLD_TCLD # BASE AND TOP OF CLOUD ELEMENTS/100. A 27. 2#5000_/3.28 DI#4000. A 29. SR#DI A 30. Y#Z/SR A 31. EL#ASINTY< A 31. EL#ASINTY< A 32. EL#EL=180./3.1416 A 33. XBI_#YAI#O. A 34. ZBI#150. A 35. YA#750. A 36. VA#1000. A 37. VA#250. A 38. HOR#5000. A 37. VA#250. A 38. HOR#5000. A 39. FLAG#0. A 40. I CONTINUE A 41. FLAG#FLAGGI A 42. KKK#0 PCYR##,7 RAD#3. A 45. BCLD#4. BCLD#4. BCLD#4. BCLD#4. C CONTINUE A 47. TCLD#9. A 45. BCLD#5. BCLD#5. BCLD#6. BCL	.c	EL # ELEVATION ANGLE.FROM.THE.SLOWER.XBC.TO.THE.FASTER.XAC.		.20
C HOR # RADIUS OF REGION OVER WHICH CLOUDS ARE EMPLACED. A 26 C PCVR # PERCENT OF COVERAGE DESIRED. A 26 C BCLD, TCLD # BASE AND TOP OF CLOUD ELEMENTS/100. A 27 Z#5000, 73.28 D1#4000. A 29 SR#01 A 30. Y#Z/SR A 31 EL#ASINXY< A 32. EL#EL*180./3.1416 A 33 XB1#XB1#00. A 34. ZB1#150. A 35. VA#750. A 35. VA#750. A 36 VA#1000. A 37 VB#250. A 39 F;AG#0. A 40 1 CONTINUE FLAG#ELAGG1 A 41 FLAG#ELAGG1 A 42 KKK#0 A 43 PCYR#4,7 A 44. RAD#3. A 45 BCLD#2.5 A 45 BCLD#2.5 A 45 BCLD#2.5 A 45 CC CHANGE THICKNESS OF CLOUD WITHOUT CHANGING BASE OR POSITION OF A 53 C ELEMENTS. *** A 56 TCLD#TCLD=BCLD A 51 TCLD#TCLD=BCLD A 51 TCLD#TCLD=BCLD A 52 C CHANGE THICKNESS OF CLOUD WITHOUT CHANGING BASE OR POSITION OF A 53 C ELEMENTS. *** A 56 TCLD#TCLDESCLO A 55 TCLD#	C	OBJECT.	Δ	23.
C HOR # RADIUS OF REGION OVER WHICH CLOUDS ARE EMPLACED. A 26 C PCVR # PERCENT OF COVERAGE DESIRED. A 26 C BCLD, TCLD # BASE AND TOP OF CLOUD ELEMENTS/100. A 27 Z#5000, 73.28 D1#4000. A 29 SR#01 A 30. Y#Z/SR A 31 EL#ASINXY< A 32. EL#EL*180./3.1416 A 33 XB1#XB1#00. A 34. ZB1#150. A 35. VA#750. A 35. VA#750. A 36 VA#1000. A 37 VB#250. A 39 F;AG#0. A 40 1 CONTINUE FLAG#ELAGG1 A 41 FLAG#ELAGG1 A 42 KKK#0 A 43 PCYR#4,7 A 44. RAD#3. A 45 BCLD#2.5 A 45 BCLD#2.5 A 45 BCLD#2.5 A 45 CC CHANGE THICKNESS OF CLOUD WITHOUT CHANGING BASE OR POSITION OF A 53 C ELEMENTS. *** A 56 TCLD#TCLD=BCLD A 51 TCLD#TCLD=BCLD A 51 TCLD#TCLD=BCLD A 52 C CHANGE THICKNESS OF CLOUD WITHOUT CHANGING BASE OR POSITION OF A 53 C ELEMENTS. *** A 56 TCLD#TCLDESCLO A 55 TCLD#	-C	XBI+YBI-ZBI # INITIAL_POSITION_OF R.		.22_
C HOR # RADIUS OF REGION OVER WHICH CLOUDS ARE EMPLACED. A 26 C PCVR # PERCENT OF COVERAGE DESIRED. A 26 C BCLD, TCLD # BASE AND TOP OF CLOUD ELEMENTS/100. A 27 Z#5000, 73.28 D1#4000. A 29 SR#01 A 30. Y#Z/SR A 31 EL#ASINXY< A 32. EL#EL*180./3.1416 A 33 XB1#XB1#00. A 34. ZB1#150. A 35. VA#750. A 35. VA#750. A 36 VA#1000. A 37 VB#250. A 39 F;AG#0. A 40 1 CONTINUE FLAG#ELAGG1 A 41 FLAG#ELAGG1 A 42 KKK#0 A 43 PCYR#4,7 A 44. RAD#3. A 45 BCLD#2.5 A 45 BCLD#2.5 A 45 BCLD#2.5 A 45 CC CHANGE THICKNESS OF CLOUD WITHOUT CHANGING BASE OR POSITION OF A 53 C ELEMENTS. *** A 56 TCLD#TCLD=BCLD A 51 TCLD#TCLD=BCLD A 51 TCLD#TCLD=BCLD A 52 C CHANGE THICKNESS OF CLOUD WITHOUT CHANGING BASE OR POSITION OF A 53 C ELEMENTS. *** A 56 TCLD#TCLDESCLO A 55 TCLD#	C	VA.VB # SPEEDS OF A AND B. VA MUST BE GREATER THAN VB.	A	23.
C POUR # PERCENT OF COVERAGE DESTRED. A 26 C BCLD_TCLD # BASE AND TOP OF CLOUD ELEMENTS/100. A 27  2#5000./3.28 A 28  DI#4000. A 29  SR#DI A 30.  Y#Z/SR A 31  EL#ASINIY< A 32.  EL#EL*180./3.1416 A 33  XBI#YBI#O. A 34.  ZBI#150. A 35.  VA#750. A 36.  VA#750. A 36.  HOR#5000. A 37  VB#250. A 38.  HOR#5000. A 39.  F.AG#O A 40.  I CONTINUE A 41.  FLAG#FLAGGI A 42.  KK##O A 43.  PCYR#.7 A 44.  RAD#3. A 45.  BCLD#4. A 40.  BCLD#2.5 A 47.  TCLD#5. A 48.  TCLD#5. A 49.  C CONTINUE A 47.  TCLD#5. A 48.  C CONTINUE A 47.  TCLD#5. A 48.  TCLD#5. A 48.  TCLD#5. A 48.  TCLD#5. A 48.  C CONTINUE A 50.  THCLD#TCLD-BCLD A 51.  DO.S. M#1.2. A 52.  C CHANGE THICKNESS OF CLOUD WITHOUT CHANGING BASE OR POSITION OF A 53.  TCLD#TCLD#CM-1<-THCLD/2. A 50.  TCLD#TCLDGXM-1<-THCLD/2. A 55.  IF XM.GI-1<-C. GO TO 3 A 57.  CALL SEI A 56.  DECIDE ON USING AN OVERLAPPING CLOUD FIELD **CLOUDO( OR A 5 59.)  C DECIDE ON USING AN OVERLAPPING CLOUD FIELD **CLOUDO( OR A 5 59.)		-RAD # RADIUS OF CLOUD ELEMENTS/100	<b>A</b>	24~
285000,/3.28		HOR # RADIUS OF REGION OVER WHICH CLOUDS ARE EMPLACED.	A	25
285000,/3.28		ROLD TOLD A BASE AND TOLD DE CLOUD ELEMENTS/100	- ·A	-20-
DIMADOO   A 29   SR#DI		7#5000_/3_28		20
SR#DI Y#Z/SR A 31 EL#ASINEY< A 32 EL#EL*180./3.1416 A 33 XBI#YGI#O. A 35 VA#750. A 36 VA#1000. A 37 VB#250. A 38 HOR#5000. A 39 FLAG#O. A 40 I CONTINUE A 41 ELAG#FLAGGI A 42 KKK#O A 43 PCVR#.*T. A 44 RAD#3. BCLD#4. BCLD#2.5 A 45 BCLD#2.5 A 45 BCLD#2.5 A 46 BCLD#2.5 A 47 TCLD#9. A 48 TCLD#5. A 49 C CONTINUE A 48 TCLD#5. A 49 C CONTINUE A 48 TCLD#5. A 49 C CONTINUE A 50 THCLD#TCLD-BCLD A 51 DD.5.M#1.2 C CHANGE THICKNESS OF CLOUD WITHOUT CHANGING BASE OR POSITION DF A 53 ELEMENTS.*** TCLD#TCLDEXM-1<*THCLD/2. A 55 LEMENTS.*** TCLD#TCLDEXM-1<*THCLD/2. A 55 LEMENTS.*** TCLD#TCLDEXM-1<*THCLD/2. A 55 LEMENTS.*** TCLD#TCLDEXM-1<*THCLD/2. A 57 CALL SET C DECIDE ON USING AN OVERLAPPING CLOUD FIELD %CLOUDOO OR A 59				
EL#ASINTY A 32 EL#EL*180*/3*1416 A 33  XBI#YQI#Q. A 35  YA#750* A 36  VA#1000* A 37  YB#250* A 38  HOR#5000* A 39  FLAG#O A 40  1 CONTINUE A 41  FLAG#FLAGG1 A 42  KKK#O A 43  PCYR#*7 A 44  RAD#3* A 45  BCLO#4* A 46  BCLO#2*5 A 47  TCLO#9* A 46  TCLO#5* A 47  TCLO#9* A 48  TCLO#5* A 47  TCLO#5* A 47  TCLO#5* A 47  TCLO#5* A 49  C CHANGE THICKNESS OF CLOUD WITHOUT CHANGING BASE OR POSITION OF A 53  ELEMENIS****  TCLO#TCLOEXM-1<*THCLOP2**  THE DO. 5. M#1.*2  C CHANGE THICKNESS OF CLOUD WITHOUT CHANGING BASE OR POSITION OF A 53  ELEMENIS****  TCLO#TCLOEXM-1<*THCLOP2**  THE TCLOEXM-1<*THCLOP2**  A 56  IF XKKKGT.0 <td>-</td> <td>SR#DI</td> <td></td> <td></td>	-	SR#DI		
EL#EL*180-/3-1416  XB1#XD1#0- 2B#150- 4 35  VA#750- A 36  VA#1000- A 37  VB#250- A 38  HOR#5000- A 39  F:AG#0- A 40  1 CONTINUE A 41  FLAG#FLAGG1 A 42  KK#00 A 43  PCVR#-7 A A44  RAD#3- BCLD#2-5 BCLD#2-5 BCLD#2-5 TCLD#5- C CHANGE THICKNESS OF CLOUD WITHOUT CHANGING BASE OR POSITION OF A 53  ELFEMENIS.***  TCLD#TCLDESCHD A 51  DO.5.M#1-2 C CHANGE THICKNESS OF CLOUD WITHOUT CHANGING BASE OR POSITION OF A 53  ELFEMENIS.*** TCLD#TCLDESCHD A 51  TCLD#TCLDESCHD A 55  ELFEMENIS.*** TCLD#TCLDESCHD A 55  ELFEMENIS.*** TCLD#TCLDESCHD A 55  C ELFMENIS.*** TCLD#TCLDESCHD A 55  C ELFMENIS.*** A 56  IF %KKK-GT-0< GO TO 3 A 57  CALL SET  DECIDE ON USING AN OVERLAPPING CLOUD FIELD %CLOUDG( OR A A 59)  DECIDE ON USING AN OVERLAPPING CLOUD FIELD %CLOUDG( OR A A 59)			A	31
XBI#YBI#O. A 34  ZBI#150. A 35  VA#750. A 36  VA#1000. A 37  VB#250. A 38  HOR#5000. A 39  F:AG#O. A 40  1 CONTINUE A 41  FLAG#FLAGGI A 42  KKK#O A 43  PCYR#.7 A 44  RAD#3. A 45  BCLD#2.5 A 47  TCLD#9. A 48  TCLD#5. A 49  2 CONTINUE A 49  2 CONTINUE A 50  THCLD#TCLD-BCLD A 51  DO.5.M#1.2  C CHANGE THICKNESS OF CLOUD WITHOUT CHANGING BASE OR POSITION OF A 53  C ELEMENTS. ***  TCLD#5. A 50  LE EMENTS. ***  TCLD#5. A 56  TCLD#5. A 56  TCLD#5. A 56  TCLD#5. A 57  CALL SET A 58  C DECIDE ON USING AN OVERLAPPING CLOUD FIELD **CLOUDGO OR A A 59				
Z8I#150				
VAM1000				
VAM1000.       A 37         VBM250.       A 38         HOR#5000.       A 40         1 CONTINUE       A 41         FLAGMELAGGI       A 42         KKK#0       A 43         PCVR#.7       A 45         BCLD#4.       A 46         BCLD#4.       A 46         BCLD#4.       A 47         TCLD#5.       A 47         TCLD#5.       A 49         2 CONTINUE       A 50         THCLD#TCLD-BCLD       A 51         DO.5.HM1.2       A 52         C CHANGE THICKNESS OF CLOUD WITHOUT CHANGING BASE OR POSITION OF A 53       A 52         C CHANGE THICKNESS OF CLOUD WITHOUT CHANGING BASE OR POSITION OF A 53       A 54         TCLD#TCLDE#M-1       A 54         TCLD#TCLDE#M-1       A 54         TCLD#TCLDEAM-1       A 54         TCLD#TCLDEAM-1       A 55         IF #KKK.GT.O       GO TO 3         CALL SET       A 57         CALL SET       A 59		<b>401#100</b> VA#75Λ		
VB#250.       A 38         HOR#5000.       A 39         FLAG#O.       A 40         1 CONTINUE       A 41         FLAG#FLAGGI       A 42         KKK#O.       A 43         PCVR#4.7       A 44         RAD#3.       A 45         BCLD#4.       A 46         BCLD#2.5       A 47         TCLD#9.       A 48         TCLD#5.       A 49         2 CONTINUE       A 50         THCLD#TCLD-BCLD       A 51         DD.5.M#1.2       A 52         C CHANGE THICKNESS OF CLOUD WITHOUT CHANGING BASE OR POSITION OF       A 52         C CHANGE THICKNESS OF CLOUD WITHOUT CHANGING BASE OR POSITION OF       A 52         C ELEMENIS.***       A 54         TCLD#TCLD&M-1<*THCLD/2.				
HOR#5000. F:AG#0.  1 CONTINUE ELAG#FLAG61 A 41  FLAG#FLAG61 A 43  PCVR#.*7 A 44  RAD#3. BCLD#4. BCLD#4. BCLD#4.  TCLD#5. A 47  TCLD#5. A 49  2 CONTINUE THCLD#TCLD-BCLD THCLD#TCLD-BCLD DD.5_M#1.*2 C CHANGE THICKNESS OF CLOUD WITHOUT CHANGING BASE OR POSITION OF A 53  ELEMENTS. *** TCLD#TCLD#TCLD/2. A 52  C CHANGE THICKNESS OF CLOUD WITHOUT CHANGING BASE OR POSITION OF A 53  C ELEMENTS. *** A 54  TCLD#TCLD#TCLD#TCLD/2. A 55  TCLD#TCLD#TCLDC#TCLD/2. A 55  C CHANGE THICKNESS OF CLOUD WITHOUT CHANGING BASE OR POSITION OF A 53  C ALL SET C DECIDE ON USING AN OVERLAPPING CLOUD FIELD #CLOUDO		_V8#250a	A	_38_
1 CONTINUE				
FLAG#FLAGE1		reading.		40_
KKK#0	1	CONTINUE		
PCVR#.7 RAD#3. BCLD#4. BCLD#2.5 TCLD#9. TCLD#5. 2 CONTINUE THCLD#TCLD-BCLD DD.5.M#1.2 C CHANGE THICKNESS OF CLOUD WITHOUT CHANGING BASE OR POSITION OF A 53 ELEMENIS.*** TCLD#TCLD#TCLD/2. A 55. A 54. TCLD#TCLDEXM-1<*THCLD/2. A 55. A 56. A 57. CALL SET C DECIDE ON USING AN OVERLAPPING CLOUD FIELD **CLOUDO<**OR** A 59.				
RAD#3. BCLD#4. BCLD#2.5 TCLD#9. A 48 TCLD#5. A 49 TCLD#5. A 49 TCLD#5. A 50 THCLD#TCLD-BCLD A 51 DD.5. M#1.2 C CHANGE THICKNESS OF CLOUD WITHOUT CHANGING BASE OR POSITION OF A 53 ELEMENIS.*** A 54 TCLD#TCLDC%M-1<*THCLD/2. A 55 IF %KKK.GT.O< GO TO 3 A 57 CALL SET C DECIDE ON USING AN OVERLAPPING CLOUD FIELD %CLOUDO< OR A 59		PU		
BCLD#4.  BCLD#2.5  TCLD#9.  TCLD#5.  2 CONTINUE  THCLD#TCLD-BCLD  DD.5 M#1.2  C CHANGE THICKNESS OF CLOUD WITHOUT CHANGING BASE OR POSITION OF A 53  ELEMENIS.***  TCLD#TCLD&\$M-1<*THCLD/2.  A 55  IF \$M.GT.1< GU TU 3  IF \$KKK.GT.0< GO TO 3  CALL SET  C DECIDE ON USING AN OVERLAPPING CLOUD FIELD \$CLOUDO< OR A 59				
BCLD#2.5 TCLD#9. A 48 TCLD#5. A 49 2 CONTINUE THCLD#TCLD-BCLD DO.5.M#1.2 C CHANGE THICKNESS OF CLOUD WITHOUT CHANGING BASE OR POSITION OF A 53 ELEMENIS.*** A 54 TCLD#TCLDEXM-1<*THCLD/2. A 55 IF XM.GT.1< GU TO 3 A 57 CALL SET C DECIDE ON USING AN OVERLAPPING CLOUD FIELD **CLOUDO<**OR A 59	Manager - series deller)		_A_	46_
TCLD#5. A 49  2 CONTINUE THCLD#TCLD-BCLD A 51  DD. 5. M#1.*2 A 52  C CHANGE THICKNESS OF CLOUD WITHOUT CHANGING BASE OR POSITION OF A 53  C ELEMENIS.*** A 54  TCLD#TCLD&\$M-1<*THCLD/2. A 55  IF \$M.GT1< GU TU 3 A 56  IF \$KKK.GT.O< GO TO 3 A 57  CALL SET A 58  C DECIDE ON USING AN OVERLAPPING CLOUD FIELD \$CLOUDO< OR A 59		BCLD#2.5		47
2 CONTINUE THCLD#TCLD=BCLD DD_5_M#1.2 C CHANGE THICKNESS OF CLOUD WITHOUT CHANGING BASE OR POSITION OF A 53 C ELEMENIS.*** A 54 TCLD#TCLD&\$M-1<*THCLD/2. A 55 IF \$M.GT.1< GU TU 3 A 56 IF \$KKK.GT.0< GO TO 3 A 57 CALL SET C DECIDE ON USING AN OVERLAPPING CLOUD FIELD \$CLOUDO< OR A A 59				
THCLD#TGLD-BCLD  DD 5 M#1.2  C CHANGE THICKNESS OF CLOUD WITHOUT CHANGING BASE OR POSITION OF A 53  ELEMENIS.***  TCLD#TGLD&*M-1<*THCLD/2.  A 55  IF **M.GT1< GU TU 3  IF **KKK.GT.O< GO TO 3  CALL SET  C DECIDE ON USING AN OVERLAPPING CLOUD FIELD **CLOUDO<**OR A 59				
DO.5. M#1.2 C CHANGE THICKNESS OF CLOUD WITHOUT CHANGING BASE OR POSITION OF A 53 C ELEMENTS. ***     TCLD#TCLD&\$M-1<*THCLD/2.     IF \$M.GT.1< GU TU 3.     IF \$KKK.GT.0< GO TO 3     CALL SET. C DECIDE ON USING AN OVERLAPPING CLOUD FIELD \$CLOUDO< OR A 59				
C CHANGE THICKNESS OF CLOUD WITHOUT CHANGING BASE OR POSITION OF A 53  C ELEMENTS. ***  TCLD#TCLD&\$M-1<*THCLD/2.  A 55  IF \$M.GT.1< GU TU 3  IF \$KKK.GT.0< GO TO 3  CALL SET  C DECIDE ON USING AN OVERLAPPING CLOUD FIELD \$CLOUDO< OR A A 59				
C ELEMENTS. ***  TCLD#TCLD&\$M-1<*THCLD/2.  A 55  IE \$M.GT.1< GU TU 3  IF \$KKK.GT.0< GO TO 3  CALL SET  C DECIDE ON USING AN OVERLAPPING CLOUD FIELD \$CLOUDO< OR A  A 59	C			
IE \$M.GT.1C GU TU 3  IF \$KKK.GT.0C GO TO 3  CALL SET  DECIDE ON USING AN OVERLAPPING CLOUD FIELD \$CLOUDOC OR A  A 59	_c		A	
IF *KKK.GT.O< GO TO 3  CALL SET  DECIDE ON USING AN OVERLAPPING CLOUD FIELD *CLOUDO< OR A A 59		TCLD#TCLD6%M-1<*THCLD/2.		
CALL SET  C DECIDE ON USING AN OVERLAPPING CLOUD FIELD **CLOUDO<** OR A A 59	****			
C DECIDE ON USING AN OVERLAPPING CLOUD FIELD *CLOUDO< OR A A 59				• •
		DECIDE ON HEINE AN OVERLADDING CLOUD SIELD TO OUDO OF A		
	<u> </u>			
CALL_CLQUDQ A. 62				_

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Table D-3. Listing of LOS1AZ (Cont'd).

CALL CAICHL CALL GILO A 65  09 4 J#1,12 A 66  AZB#30.0**J-1< CALL CLR A 68  AZA#AZBG155. A 70 C DECIDE ON A DIRECT INTERCEPT THUNTOX OR TAIL CHASING THUNTOX C SIENARIO. CALL HUNTO XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX	3 CONTINUE	A 63
CALL GILO  OD 4 JHL112  AZB #30.0*4 J-1 C  AZB #30.0*4 J-1 C  CALL CLR.  A 68  AZB #AZB £155.  A 70  C DECIDE ON A DIRECT INTERCEPT ** THUNID COR TAIL CHASING ** HUNIC C  A 71  C SLENARID.  A 72  CALL HUNTD  A 73  XK #KK-1.  CALL CLRX  A 74  CALL FREE  A 76  AZA #AZB-25.0  A 77  AZA #AZB-25.0  A 77  AZA #AZB-155.  A 78  CALL HUNTD  A 79  KK #KK-1  CALL LORX  A 76  CALL CLRX  A 76  CALL CLRX  A 77  AZA #AZB-155.  A 78  CALL HUNTD  A 79  KK #KK-1  CALL CLRX  A 81  CALL CLRX  A 81  CALL CLRX  A 81  CALL GIL1  A 82  CALL GIL1  A 83  CONTINUE  A 84  CALL GIL2  A 84  CALL GIL2  A 85  COVER #FC VR  PRINT 8, BCLD, TCLD, RAD, COVER  S COVER #C VR  PRINT 8, BCLD, TCLD, RAD, COVER  A 87  C CHANGE BASES OF CLOUD MITHOUT CHANGING THE POSITION OF THE  A 90  C ELEMENTS.  BCLD #BCLD #BCLD # A 91  BCLD #BCLD # A 92  GD ID .2  A 94  CONTINUE  A 95  GD ID .2  A 96  CONTINUE  A 97  A 98  FORMAT \$//,10x,29MABOVE INFU BASED ON - BASE # ,F5.1,8H,TOPS # ,F5 A 99  L.1,11H ,RADIUS # ,F5.1,13H ,COVERAGE # ,F6.3C  A 100		- 1
DO 4 J#1-12		
A 25 #30.0 * £ J - 1 <		
CALL CLR		
AZA#A7US25-0 AZA#AZBS155. C DECIDE ON A DIRECT INTERCEPT THUNTD OR TAIL CHASING THUNTC A 71 C SCENARIO. CALL HUNTO A 73 XKWKK-1 CALL CLRX A 75 CALL LEREE A 76 AZA#AZB-25.0 A 77 AZA#AZB-155. A 78 CALL HUNTO A 79 KKWKK-1 A 79 KKWKK-1 A 80 CALL CLRX A 81 CALL CLRX A 80 CALL GIL1 A 80 CALL GIL1 A 80 CALL GIL2 A 82 CALL GIL1 A 83 CONTINUE A 84 CALL GIL2 A 85 CONTINUE A 86 PRINT 8, BCLD, TCLD, RAD, COVER C CLANGE BASES OF CLOUD WITHOUT CHANGING. THE POSITION OF THE A 90 C ELEMENTS. A 91 BCLD BBCLD DL 5 BC DL 0.2 BC CONTINUE A 92 BC TO A1, 7C, FLAG A 95 GO ID 2 B FORMAT \$//,10x,29HABOVE INFO BASED ON — BASE #,F5.1,8H,TOPS #,F5 A 99 L.1,11H, RADIUS #,F5.1,13H, COVERAGE #,F6.3C A 100		
AZAMAZBSLISS.  C DECIDE ON A DIRECT INTERCEPT THUNIDG OR TAIL CHASING THUNICG A 71  C SCENARIO. A 72  CALL HUNTO A 73  KK#KK-1 A 74  CALL CLRX A 75  CALL FREE A 76  AZAMAZB-25.0 A 77  AZAMAZB-155. A 78  CALL HUNTO A 79  KK#KK-1 A 80  CALL LRX A 81  CALL CLRX A 81  CALL CLRX A 81  CALL EREE A 85  CALL GIL1 A 53  4 CONTINUE A 86  CALL GIL2 A 85  COVERMPCVR A 86  PRINT 8, BCLD, TCLD, RAD, COVER A 87  S. CONTINUE A 87  C. CHANGE BASES OF CLOUD MITHOUT CHANGING THE POSITION OF THE A 90  C ELEMENTS. A 92  IF *KKK.G1.2< GD TO 6 A 93  GO IO.2 A 94  6 CONTINUE A 94  6 CONTINUE A 95  CONTINUE A 94  6 CONTINUE A 95  CONTINUE A 97  A 97  A 97  A 97  C S FORMAT \$//, IOX, 29HABOVE INFO BASED ON — BASE # , F5.1, 8H, TOPS # , F5 A 99  L.1, 11H , RADIUS # , F5.1, 13H , COVERAGE # , F6.35  A 100		
C DECIDE ON A DIRECT INTERCEPT \$HUNTD( OR TAIL CHASING \$HUNTC( A 71 SCENARIO. A 72 CALL HUNTO A 73 KK#KK-1. A 74 CALL CLRX A 75 CALL EREE A 75 CALL FREE A 76 A 76 A 77 A 78 A 78 A 78 A 78 A 78		
C SCENARIO. A 77  CALL HUNYD A 73  KK#KK-1. A 74  CALL CLRX A 75  CALL FREE A 76  AZA#AZB-25.0 A 77  AZA#AZB-155. A 78  CALL HUNTD A 79  KK#KK-1 A 80  CALL CLRX A 81  CALL CLRX A 81  CALL CLRX A 81  CALL GIL1 A 82  CALL GIL1 A 83  CALL GIL1 A 83  CALL GIL2 A 85  COVER#PCVR A 84  CALL GIL2 A 85  COVER#PCVR A 86  PRINT 8, BCLD, TCLD, RAD, COVER A 87  S. CONTINUE A 88  KKK#KKK1 A 89  C ELEMENTS A 89  C ELEMENTS A 89  C CONTINUE A 89  C C CHANGE BASES OF CLOUD MITHOUT CHANGING THE POSITION OF THE A 90  B CONTINUE A 92  A 92  A 93  GO IO 2 A 94  CONTINUE A 95  GO IO 31,77, FLAG A 95  A 97  C S FORMAT \$//,10X,29HABOVE INFO BASED ON - BASE # ,F5.1,8H,TOPS # ,F5 A 99  1.1,11H ,RADIUS # ,F5.1,13H ,COVERAGE # ,F6.3<  A 100		
CALL HUNTO  KK#KK-1  CALL CLRX  CALL FREE  A 75  CALL FREE  A 76  AZA#AZB-25.0  A 77  AZA#AZB-155.  CALL HUNTO  KK#KK-1  CALL CLRX  A 80  CALL CLRX  A 81  CALL CLRX  A 81  CALL FREE  CALL GIL1  A 63  4 CONTINUE  A 85  COVER#PCVR  PRINT 8, BCLD.TCLD,RAD,COVER  S.COVER#CVR  KKK#KKKG1  A 87  C CHANGE BASLS OF CLOUD MITHOUT CHANGING THE POSITION OF THE A 90  C ELEMENTS.  A 91  BCL D#BCL DELS  A 92  IF %KKK.GI.2< GO TO 6  A 93  GO IO.2  6 CONTINUE  A 95  GO TO 21,7<, FLAG  7 CONTINUE  A 95  GO TO 21,7<, FLAG  8 FORMAT %//,10X,29HABOVE INFO BASED ON - BASE # ,F5.1,8H,TOPS # ,F5 A 99  1.1,11H ,RADIUS # ,F5.1,13H ,COVERAGE # ,F6.3<  A 100		
KK#KK-1		A 73
CALL CLRX CALL FREE A 76 AZA#AZB=25.0 A 77 AZA#AZB=155. CALL HUNTD A 79 KK#KK-1 CALL CLRX A 80 CALL CLRX A 81 CALL EREE A 82 CALL GIL1 A 63 4 CONTINUE A 84 CALL GIL2 A 85 COVER#PCVR PRINT 8, BCLD.TCLD,RAD,COVER A 87 S. CONTINUE A 88 KKK#KKKC1 A 89 C CHANGE BASES OF CLOUD WITHOUT CHANGING THE POSITION OF THE A 89 C ELEMENTS. BCLD#BCLDC1.5 IF %KKK.G1.2< GD TO 6 A 93 GO TO 21.7<, FLAG 7 CONTINUE A 96 7 CONTINUE A 96 7 CONTINUE A 97 A 96 8 FORMAT %//,10X,29HABOVE INFO BASED ON — BASE # ,F5.1,8H,TOPS # ,F5 A 99 1.1,11H ,RADIUS # ,F5.1,13H ,COVERAGE # ,F6.3< A 100	*****	
CALL FREE AZAMAZB-25.0 A 77 AZAMAZB-155. CALL HUNTD  KK#KK-1 A 80 CALL CLRX A 81 CALL FREE CALL GIL1 A 82 CALL GIL1 A 83 CALL GIL2 A 85 COVER#PCVR PRINT 8, BCLD, TCLD, RAD, COVER PRINT 8, BCLD, TCLD, RAD, COVER  KKK#KKKG1 A 89 C CHANGE BASES OF CLOUD WITHOUT CHANGING THE POSITION OF THE A 90 C ELEMENTS. BCLD#BCLDEL5 BCLD#BCLDEL5 A 92 IF *KKK.GI.2< GD TO 6 A 93 GO TO 21.7<, FLAG 7 CONTINUE A 96 A 97 C SERMAT *//, 10X, 29HABOVE INFO BASED ON - BASE *, F5.1, 8H, TOPS *, F5 A 99 1.1, 11H , RADIUS *, F5.1, 13H , COVERAGE *, F6.3< A 100		A 75
A 77 AZA#AZB=155. A 78 CALL HUNTD A 79 KK#KK-1 A 80 CALL CLRX A 81 CALL EREE A 82 CALL GIL1 A 53 4 CONTINUE A 84 CALL GIL2 A 85 COVER#PCVR A 86 PRINT 8, BCLD, TCLD, RAD, COVER A 87 5 CONTINUE A 88 KKK#KKKGI A 89 C CHANGE BASES OF CLOUD WITHOUT CHANGING THE POSITION OF THE A 90 C ELEMENIS A 91 BCL D#BCL DCL_5 A 93 GO TO 2 A 94 6 CONTINUE A 94 6 CONTINUE A 94 6 CONTINUE A 94 6 CONTINUE A 95 GO TO 21,7<, FLAG A 95 1-1,11H ,RADIUS # ,F5-1,13H ,COVERAGE # ,F5-1,8H,TOPS # ,F5 A 99 1-1,11H ,RADIUS # ,F5-1,13H ,COVERAGE # ,F6-3< A 100		.A 76
A 78 CALL HUNTD CALL HUNTD KK#KK-1 CALL CIRX A 80 CALL CIRX A 81 CALL EREE A 82 CALL GIL1 A 63 4 CONTINUE A 84 CALL GIL2 COVER#PCVR A 86 PRINT 8, BCLD, TCLD, RAD, COVER PRINT 8, BCLD, TCLD, RAD, COVER KKK #KKKG1 A 89 C CHANGE BASES OF CLOUD WITHOUT CHANGING THE POSITION OF THE A 90 C ELEMENTS A 91 HCLD#BCLDE1-5 A 91 GO IO.2 A 93 GO IO.2 A 94 6 CONTINUE A 95 GO TO 31,7<, FLAG 7 CONTINUE A 96 C SERMAT \$//,10X,29HABOVE INFO BASED ON - BASE # ,F5-1,8H,TOPS # ,F5 A 99 1.1,11H ,RADIUS # ,F5-1,13H ,COVERAGE # ,F6-3< A 100		A 77
KK#KK-1	The state of the s	
CALL CLRX  CALL EREE  CALL GIL1  A 63  4 CONTINUE  CALL GIL2  COVER#PCVR  PRINT 8, BCLD, TCLD, RAD, COVER  S CONTINUE  KKK #KK C1  C CHANGE BASES OF CLOUD WITHOUT CHANGING THE POSITION OF THE  KKK #KK G1.2 < GO TO 6  GO TO 2  6 CONTINUE  GO TO 21.7 <, FLAG  7 CONTINUE  8 FORMAT \$//,10x,29HABOVE INFU BASED ON - BASE #,F5.1,8H,TOPS #,F5 A 99  1.1,11H ,RADIUS #,F5.1,13H ,COVERAGE #,F6.3 < A 100	CALL HUNTO	A 79
CALL EREE CALL GIL1 A 63 4 CONTINUE A 84  CALL GIL2 A 85  COVER#PCVR A 86 PRINT 8, BCLD, TCLD, RAD, COVER  KKK #KKK 61 C CHANGE BASES OF CLOUD WITHOUT CHANGING THE POSITION OF THE A 90 C ELEMENTS BCLD#BCLDEL5 A 91 IF *KKK GI 2 GD TO 6 GD TO 21, 7 <, FLAG 7 CONTINUE A 95  6 FORMAT \$ // , 10 X, 29 HABOVE INFO BASED ON — BASE # , F5 1, 8 H, TOPS # , F5 A 99 1 1, 1, 11 H , RADIUS # , F5 1, 13 H , COVERAGE # , F6 3 < A 100	KK#KK-1	
CALL GIL1 4 CONTINUE A 84  CALL GIL2 COVER#PCVR PRINT 8, BCLD.TCLD.RAD.COVER A 87  5 CONTINUE KKK#KKK61 C CHANGE BASES OF CLOUD WITHOUT CHANGING THE POSITION OF THE C ELEMENTS. BCLD#BCLD61.5 A 91  IF %KKK.GI.2< GD TO 6 GO TO 21.7<, FLAG 7 CONTINUE GO TO 21.7<, FLAG 7 CONTINUE A 96  8 FORMAT \$//.10x,29HABOVE INFO BASED ON - BASE # ,F5.1,8H,TOPS # ,F5 A 99 1.1,11H ,RADIUS # ,F5.1,13H ,COVERAGE # ,F6.3< A 86  A 87  A 87  A 98	CALL CLRX	A 81
4 CONTINUE CALL GIL2 COVER#PCVR PRINT 8, BCLD,TCLD,RAD,COVER S. CONTINUE KKK #KKKGI C. CHANGE BASES OF CLOUD WITHOUT CHANGING THE POSITION OF THE A 89 C ELEMENTS. A 91 IF **EKK.GI.2< GD TO 6 GO TO .2 6 CONTINUE GO TO .31.7<, FLAG 7 CONTINUE A 96 7 CONTINUE A 97 C 8 FORMAT **//*10X,29HABOVE INFO BASED ON - BASE **,F5-1,8H,TOPS **,F5 A 99 1.1,11H ,RADIUS **,F5-1,13H ,COVERAGE **,F6-3< A 100	CALL_EREE	A .82
CALL GILZ COVER#PCVR PRINT 8, BCLD, TCLD, RAD, COVER  S. CONTINUE KKK #KKK £1 C. CHANGE BASES OF CLOUD WITHOUT CHANGING THE POSITION OF THE C. ELEMENTS. BCLD#BCLD£1-5 A 92 IF *KKK.GI.2< GD TO 6 A 93 GO TO 2 6 CONTINUE GO TO 21,7<, FLAG 7 CONTINUE A 96 A 97 C.  8 FORMAT *//*10X,29HABOVE INFO BASED ON - BASE * ,F5-1,8H,TOPS * ,F5 A 99 1.1,11H ,RADIUS * ,F5-1,13H ,COVERAGE * ,F6-3< A 86 A 86 A 87 A 87 A 88 A 90 A 90 A 90 A 91 A 92 A 93 A 94 A 95 A 96 A 96 A 97 A 98 A 100	CALL GIL1	А 63
COVER#PCVR PRINT 8, BCLD.TCLD.RAD.COVER  S. CONTINUE KKK #KKK £1 C. CHANGE BASES OF CLOUD WITHOUT CHANGING THE POSITION OF THE C. ELEMENTS. BCLD#BCLD£1.5 A 91 IF *KKK.G1.2< GD TO 6 A 93 GO TO 2 CONTINUE GO TO 21.7<, FLAG 7 CONTINUE A 96 FORMAT *//*10X,29HABOVE INFO BASED ON - BASE * ,F5.1,8H,TOPS * ,F5 A 99 1.1,11H ,RADIUS * ,F5.1,13H ,COVERAGE * ,F6.3< A 87 A 88 A 90	4_CONTINUE	A84
PRINT 8, BCLD, TCLD, RAD, COVER  5. CONTINUE  KKK #KKK £1  C. CHANGE BASES OF CLOUD WITHOUT CHANGING THE POSITION OF THE  C. ELEMENTS.  BCLD#BCLD£1-5  IF *KKK.G1.2< GD TO 6  GO TO.2  6 CONTINUE  GO TO.31,7<, FLAG  7 CONTINUE  A 97  C  8 FORMAT *//*10X,29HABOVE INFO BASED ON - BASE * ,F5.1,8H,TOPS * ,F5 A 99  1.1,11H ,RADIUS * ,F5.1,13H ,COVERAGE * ,F6.3<  A 87  A 88  A 90  A 90  A 91  A 92  A 93  A 94  A 95  A 96  A 97  A 98	CALL GIL2	A 85
S. CONTINUE  KKK #KKK 61  C. CHANGE BASES OF CLOUD WITHOUT CHANGING THE POSITION OF THE  ELEMENTS.  BCL D#BCL DE1.5  IF *KKK.GI.2< GD TO 6  GO TO.2  6 CONTINUE  GO TO 31,7<, FLAG  7 CONTINUE  A 96  7 CONTINUE  A 97  A 98  FORMAT *//*10X,29HABOVE INFO BASED ON - BASE * ,F5.1,8H,TOPS * ,F5 A 99  1.1,11H ,RADIUS * ,F5.1,13H ,COVERAGE * ,F6.3<  A 89  A 88  A 90  A 90  A 90  A 90  A 91  A 92  A 93  A 94  A 95  A 96  A 97  A 98		88. A.
KKK #KKK 61	PRINT 8, BCLD,TCLD,RAD,COVER	A 87
C CHANGE BASES OF CLOUD WITHOUT CHANGING THE POSITION OF THE A 90 C ELEMENTS. A 91 BCLD#BCLDE1.5 A 92 IF *KKK.GI.2< GD TO 6 A 93 GO TO.2 A 94 CONTINUE A 95 GO TO 31,7<, FLAG A 96 7 CONTINUE A 97 C 8 FORMAT *//.10x,29HABOVE INFO BASED ON - BASE * ,F5.1,8H,TOPS * ,F5 A 99 1.1,11H ,RADIUS * ,F5.1,13H ,COVERAGE * ,F6.3<	S_CONTINUE	. 888 .
C ELEMENTS. A 91  BCL D#BCLDE1-5  IF %KKK.G1.2< GD TO 6  GO TO.2  6 CONTINUE  GO TO.31,7<, FLAG  7 CONTINUE  A 95  A 96  A 97  A 98  FORMAT %//,10x,29HABOVE INFU BASED ON - BASE # ,F5-1,8H,TOPS # ,F5 A 99  1.1,11H ,RADIUS # ,F5-1,13H ,COVERAGE # ,F6-3<  A 91  A 92  A 93  A 94  A 95  A 96  A 97  A 98  A 100		
### ##################################	CCHANGE BASES OF CLOUD WITHOUT CHANGING THE ROSLITION OF THE	A .90
IF %KKK.GI.2< GO TO 6  GO TO.2  6 CONTINUE  A 95  GO TO \$1.7<, FLAG  7 CONTINUE  A 97  C  8 FORMAT %//.10x,29HABOVE INFU BASED ON - BASE # ,F5.1,8H,TOPS # ,F5 A 99  1.1,11H ,RADIUS # ,F5.1,13H ,COVERAGE # ,F6.3<  A 100	C ELEMENTS.	
GO TO 2 6 CONTINUE A 95 GO TO 31,7<, FLAG 7 CONTINUE A 97 C 8 FORMAT \$//.10x,29HABOVE INFU BASED ON - BASE # ,F5.1,8H,TOPS # ,F5 A 99 1.1,11H ,RADIUS # ,F5.1,13H ,COVERAGE # ,F6.3< A 100	BCLD#BCLDEL-5	
6 CONTINUE  GO TO \$1.7<, FLAG  7 CONTINUE  8 FORMAT \$//.10x,29HABOVE INFU BASED ON - BASE # ,F5.1,8H,TOPS # ,F5 A 99  1.1,11H ,RADIUS # ,F5.1,13H ,COVERAGE # ,F6.3<  A 95  A 95  A 96  A 97  A 98  A 100	IF %KKK.GI.2< GO TO 6	
GO TO 31,7<, FLAG 7 CONTINUE A 97 C 8 FORMAT \$//.10X,29HABOVE INFU BASED ON - BASE # ,F5.1,8H,TOPS # ,F5 A 99 1.1,11H ,RADIUS # ,F5.1,13H ,COVERAGE # ,F6.3< A 100	GO .T.O .2	
7 CONTINUE  A 97  A 98  8 FORMAT \$//.10X,29HABOVE INFU BASED ON — BASE # ,F5.1,8H,TOPS # ,F5 A 99 1.1,11H ,RADIUS # ,F5.1,13H ,COVERAGE # ,F6.3<  A 100	6 CONTINUE	A 95
8 FORMAT \$//.10X,29HABOVE INFO BASED ON - BASE # ,F5.1,8H.TOPS # ,F5 A 99 1.1,11H ,RADIUS # ,F5.1,13H ,COVERAGE # ,F6.3<		
8 FORMAT \$//.10X.29HABOVE INFO BASED ON - BASE # .F5.1.8H.TOPS # .F5 A 99 1.1.11H .RADIUS # .F5.1.13H .COVERAGE # .F6.3<	7 CONTINUE	A 97
1.1,11H ,RADIUS # ,F5.1,13H ,COVERAGE # ,F6.3<		
1.1,11H ,RADIUS # ,F5.1,13H ,COVERAGE # ,F6.3<	8 FORMAT %//,10X,29HABOVE INFO BASED ON - BASE # ,F5.1,8H,TOPS # ,i	₹5 A 99
END A 101-		A. 100
	END	A 101-

大学中心,我们是这个人的人,我们就是这个人的人,我们就是这种人的人的人,我们也是这个人的人的人,我们也会会会会会会会会会,这个人的人,也是这种人的人,也是这种人的

Table D-4. Listing of Subroutines.

			,
	SUBROUTING SET	·· A =	<u>5</u>
С	THIS SUBROUTINE INITIALIZES REQUIRED OPERATING VALUES. ***	A	3
	CALL CLOOVE		4
	CALL HUNTF	A	<u>5</u>
-	CALL FREEF	Ã	6
	CALL MAPF	4	7
	RETURN	Ā	8
	END	<u> </u>	9-
	SUBROUTINE CLONO	В	
C	THIS SUBROUTINE GENERATES THE CLOUD FIELD TO BE EXAMINED. *****	В	1
<u>C</u>	*CLONO PRODUCES A NON-OVERLAPPING CLOUD FIELD AND CAN BE USED	8	<u>2</u> 3
Č	FOR COVERAGE UP TO ABOUT 45 PERCENT. SUBROUTINE CLUOVE IS	8	4
C	RECOMMENDED FOR COVERAGES GREATER THAN 45 PERCENT.	В	5
	COMMON \BLKI\ XCTD*1000<''ACTD*1000<'''	В	6
	CUMMON /BLK7/ BCLD, TCLD, PCVR, RAD, HOR	В	7
<u>C</u> _	<u>INITIAL [ZE *****</u>	8	8
	SML#0.0001	В	9
	JJ#0	<u>_B</u>	10
	JPSS#2000	ß	11
	PY#3.1416\$CDR#PY/180.0\$CRD#1.0/CDR	В	12
	XRA#2.*%HOR-RAD*100.<\$FRA#RAD*100.\$DRA#2.*FRA CYR#PCVR\$CLOS#0.0\$BMP#PY*FRA**2	8	13 14
	TAR#PY*HOR**2	<u>в</u> 8	15
	CDUCECONDACO	8	16_
	CALL RANSET *CP<	- 3	17
. <b>C</b> .			18
	RETURN	В	19
ma.	ENTRY CLOUDNO	Ð	2,0
	PRINT 7	В	15
1	CONTINUE	B	_22
С	*** TEST FOR PERCENTA LOUD COVER REACHED ****	В	23
	PCNT#CLDS/TAR	8	24
,	IF TPCNT.GT.CVRC GO TO 5	8	25
<u>C</u> S	CONTINUE TEST FOR OVER 2000 PASSES ***	8	26 27
C	JPSS#JPSS-1	8 B	28
	IF %JPSS.LT.1< GO TO 5	8	29
	KPSS#2000-JPSS	8	30
C	**** DBTAIN X AND Y COURDINATES FRUM RANDOM NUM GEN ***	B	31
	RX#RANF%PY<\$RY#RANF%PY<	В	32
	XP#RX~XRA-%HOR-RAD*100.<\$YP#RY*XRA-%HOR-RAD*100.<	B	33
	RP#0.0\$ARG#XP**2&YP**2	<u>B_</u>	34
•	IF %ARG.GT.SML< RP#SQRT%ARG<	В	35
C.	**TEST FOR X AND Y WITHIN ACCEPTABLE LIMITS ***	8	36
c	IF TRP-GT-THOR-RAD*100.<< GO TO 2	8	37
Ċ	TEST FOR OVERLAP ON OTHER CLOUDS.****  J#1	- β Β	38 39
3	CONTINUE	. B	40
	IF %J.GT.JJ< GO TO 4	<u> </u>	41
	XJ#XCLD%J<\$YJ#YCLD%J<	В	42
	XT#XPXJ\$YT#YPYJ\$RT#0.0	8	43
	ARG#XT**26YT**2	В	44
	IF %ARG.GI.SML< RT#SQRT%ARG<	13	45
	IF TRILLIORAS GO TO 2	В	46
	AAA GI	8	47
* * *		B	4.8

Table D-4. Listing of Subroutines (Cont'd).

4	CONTINUE	В	49
. <b>C</b> .	*** X.AND Y HAVE BEEN ACCEPTED ****	B	50
С	* STORE RESULTS ***UPDATE CLOUD COVER ***PRINT **		51
	131181		
	XCLO%JJ<#XP\$YCLU%JJ<#YP	В	
	CLDS#CLDS68MP		_54_
C.	PRINT 8, JJ, XP, RP, CLDS, PCNT, KPSS	8	
	GO TO 1		
5	CONTINUE	8	
	PCVREPCNT		
	SCL#0.01	В	59
	DO 6 J#L-JJ  * STORE SCALED VALUES OF THE CLOUD COORDINATES ***  XCLD%J<#XCLD%J<#SCL\$YCLD%J<#SCL	B	_60_
С	* STURE SCALED VALUES OF THE CLOUD COURDINGTES ***	В	61
6	CONT INUT		63
	PRINT 8.JJ.XP.YP.RP.CLDS.PCNLT.KPSS		
	RETURN		65
_c			
C		_	67
.ي			.68
7	FORMAT %1H1/10X, 2HJJ, 11X, 1HX, 11X, 1HY, 11X, 1HR, 8X, 4HCLDS, 8X, 4HPCNT, 6		
	1X,4HKPSSC	B	.7.0
8	FORMAT \$2X,110,4F12.1,F12.3,110<		71 72-
30-00-00 3-00-00			
C C	SUBROUTINE CLOUVR THIS SUBROUTINE PRODUCES A CLOUD FIELD WHICH ALLOWS FOR SOME OVERLAPPING OF INDIVIDUAL ELEMENTS. ANY NEWLY INTRODUCED ELEMENT	C C,	2
_C	IS ALLONED TO DYERLAP NO OTHER OR ONE OTHER CLOUD ELEMENT. IF THE		
С	NEWLY INTROJUCED ELEMENT WOULD OVERLAP TWO OR MORE EXISTING ELEMEN		
С	IT IS REJECTED. THE RESULT IS THAT STRINGS OF CLOUDS ARE POSSIBLE		
С	BUT GROUPS OF MORE THAN TWO CLOUDS ARE NOT POSSIBLE. ***	C	•
	COMMON /BLK1/ XCLD%1000<,YCLD%1000<,JJ	C	_
_	COMMON /BLK7/ BCLD, TCLD, PCVR, RAD, HOR	C	
	#ARESTONITITIALIZE TETER.		_10_
	SML#0.0001	C	
	JJ#0	C	
	JPSS#NPSS#1000		13
	PY#3.1416\$CDR#PY/180.0\$CRD#1.0/CDR		14.
	XRA#2.*3HOR-RAD*100.<		15
	ERA#RAD*1QOA		<del></del>
	DRA#2.*FRA	_	17
	CVR #PCVR		18
	6MP#PY*FRA*Z.	C	19
	TAR#PY*HOR**2 CLDS#0.0	C	20
	CD\$#O.O	C_	21 _22_
		L.	23
r	CALL RANSET *CP< ************* END OF INITIALIZE *******	C	
С	RETURN	C	25
	ENTRY CLOUDO	C	26
	PRINT 9	C	27
1	CONT INUF	Ċ	
i Č	\$\$\$ TEST FOR PRECENTAGE CLOUD COVER REACHED. \$\$\$\$	Ċ	29
C	PENT#CLDS/TAR	Ċ	30_
****** ** **	IF TPCNT.GT.CVRC GO TO 6	<u>\</u>	31
	TO CECIAL OF CAUN OF TO D	U	2 L

Table D-4. Listing of Subroutines (Cont'd).

_2	CONTINUE	C _ 32
- <del>c</del>	** TEST FOR OVER 1000 PASSES ****	C 33
•	JPSS#JPSS-1	C 34
	IF %JPSS.LT.1< GO TO 6	C 35
	KPSS#MPSS-JPSS	C 36
С	**** OBTAIN X AND Y COURDINATES FROM RANDOM NUM GEN ***	C 37
	RX#RANF%PYC\$RY#RANF%PYC	C 38
	XP#RX#XRA-%HOR-RAD#100.<	C 39
	YP#RY+XRA-%HOR-RAD*100.<	<u>C 40</u>
	RP#0.0\$ARG#XP**2&YP**2	C 41
	IF %ARG.GT.SML< RP#SQRT%ARG<	C 42
С	**TEST FOR X AND Y WITHIN ACCEPTABLE LIMITS ***	C 43
	IF %RP.GT.%HOR-RAD*100.<< GO TO 2	<u>C 44</u>
С	*TEST FOR OVERLAP ON OTHER CLOUDS. ***	C 45
	J#1	<u>C 46</u>
	KBMP#1	C 47
	BMPX#BMP	C 48
3	CONT INUE	C 49
	IF %J.GT.JJ< GO TO 5	C 50
	XJ#XCLD&J<\$YJ#YCLD&J<	C 51
	XT#XP-XJ\$YT#YP-YJ\$RT#O.O	C 52
	ARG#XY**2&YT**2	C 53
	IF %ARG.GT.SML< RT#SQRT%ARG<	<u>C_54</u>
	IF %RT.LT.DRA< GO TO 8	C 55
4	CONT INUE	C 56
	J#J&1	C 57
	GO TO 3	C 58
5	CONT INUE	C 59
С	*** X AND Y HAVE BEEN ACCEPTED ****	C 60
С	* STORE RESULTS ***UPDATE CLOUD COVER ***PRINT **	C 61
	JJ#JJ61	<u>C 62</u>
	XCLDZJJ<#XP\$YCLDZJJ<#YP	C 63
	CLDS#CLDS&BMPX	C 64
	60 TO 1	C 65
6	CONT INUE	C 66
	PCVR #PCNT	C 67
	SCL #0.01	C 68
	DO 7 J#1,JJ	C 69
	XCLD%J<#XCLD%J<*SCL\$YCLD%J<#YCLD%J<*SCL	<u> </u>
7	CONTINUE	C 71
	PRINT 10, JJ.XP.YP.RP.CLOS.PCNT.KPSS	C72_
	RETURN	C 73_

## Table D-4. Listing of Subroutines (Cont'd).

8 C C	CUNTINUE TEST FOR OVERLAP ON MORE THAN ONE ILEMENT. REJECT OF THE NEW ELEMENT OVERLAPS MORE THAN ONE OTHER ELEMENT, OR IF IT OVERLAPS BY A DISTANCE GREATER THAN THE RADIUS OF THE OVERLAPPED ELEMENT.**  1E TRI.LI.FRAS GO TO 2		74 15 16 77 78,
0,00	TF TKBMP.LI.I< GO TO 2 *DETERMINE THE ADDITIONAL COVERAGE INDUCED BY THE POTENTIALLY ACCEPTABLE NEW ELEMENT. NOTE THAT THE ADDITIONAL COVERAGE WILL NO BE USED IF A MOVE IS MADE TO ADDRESS 2 BEFORE A MOVE IS MADE TO ADDRESS 5. *** DIWRT D2#DRA-D1 _D3#ERA-D2Z2.0		79 80 81 82 83 84 85 86
	D4#0.0\$ARG#FRA**2-D3**2 IF %ARG.GI.SML< D4#SWRI%ARG< ARG#D4/DRA ARG#D4/DRA\$ANG#2.0*ASIN%ARG< RAT#ANG/%2.0*PY <ai#d3±d4 2.0\$a2#rai%bm2\$a3#2.0%%a2-a1<<="" td=""><td>000000</td><td>87 88 89 90 91 92</td></ai#d3±d4>	000000	87 88 89 90 91 92
C C	BMPX#BMPX-A3 KBMP#KBMP-1 GO 10 4		93 94 95 96 97 98
9	FORMAT KIHI/10X, 2HJJ, LIX, 1HX, LIX, LHY, LIX, LHR, 8X, 4HCLOS, 8X, 4HPCN1, 6 1X, 4HKPSS< FORMAT %2X, 110, 4F12.1, F12.3, 110< END	C	99 100 101 102-
C C	SUBROUTING HUNTS  † THIS SUBROUTING DETERMINES THE PORTIONS OF THE VEHICLES IS A FUNCTION OF SIMULATED TIME. ***  COMMON /BLKZ/ PXAX100<,PYAX100<,PZAX100<,PXBX100<,PYBX100<	0 0 0 0	1 2 3 4
magalipinus, te	1 <tab\$100<+dab\$100<+kk _common_zblk3z_aza+azb+el+xbl+xbl+zbl+dl+xa+xb="" _common_zblk4z_kcnz200<+kl+l1ma\$4<+l1mb\$4<="" _common_zblk5z_cldb="" _common_zblk6z_j="" _common_zblk6z_j<="" td=""><td>0 0 0 0 0</td><td>5 6 7 8 9</td></tab\$100<+dab\$100<+kk>	0 0 0 0 0	5 6 7 8 9
c 	INITIALIAE.***** SML#0.00001.  PY#3.1416*CDR#PY/180.0*CRD#1.0/CDR  END OF INITIALIZE.*****  RETURN  ENTRY HUNID	0 0 0 0 0	11 12 13 14 15

Table D-4. Listing of Subroutines (Cont'd).

C C	DETERMINE POSITIONS FOR DIRECT INTERCEPT MODEL USING TIME STEPS OF O.2. SECONDS. NOTE THAT IN THIS MODEL THE ELEVATION ANGLE REMAINS.	n _n_	17 _1.8
C	CUNSTANT. ***	D	19
	PHI #EL	D	20
С	PRINT 13, AZA, AZB, EL, DI, ZBI	0	21
	A#CDR+AZB\$VXB#CUSXA<+VB\$VYB#SINXA<*VB	0	22
	A#CDR*AZA\$E#CDR*EL _XAL#D1:hCOSXEChCOSXAC	9	23
	YAI #DI * COS * L < * SIN * A <	_u_ D	25
	ZAI#DI*SIN*E <czbi< td=""><td>Ď</td><td>26</td></czbi<>	Ď	26
	XANXAISYANYAISZANZAI	Ď	27
	XBM XBI \$YBM YBI \$ZBM ZBI \$DMDI	Ď	28
	CLDB#BCLD	υ	29
	CASSAN	_0_	٥٤
	TH#0.0	D	31
	J1M#0\$JDL1#20	D	32
	D1#J0L1/100.0	D	33
С	KK#O PRINT 11	D D	34 35
=	KFLAG#0	D	36
	KF#KL/5081	D	37
C	DETERMINE THE FINAL X.Y POSITION OF THE VEHICLES. ***		
	A#CDR*AZB	D	39
	DUMI#COSTA<+TXAEYA~IANTA<<	D	40
	DUM2#\$VA**2/VB**2<-1.	O	41
	DB4&-DUM16 SQRT &DUM1**26DUM2*DI** 2< <td>0</td> <td>42</td>	0	42
	XF#DB*COSTAC	0	
	YE#DB%\$INTA< DA#\$QR\TTXF-XA<**2&\YE-YA<**2&\ZB-ZA<**2<		
	P#XXF-XA <td>Ď</td> <td></td>	Ď	
1	CONTINUE	Ď	
Ċ	DETERMINE POSITIONS OF A AND B. FOR THE FINAL POSITION JUST CALCUL	Ö	
Č	ATED, EVERY 0.2 STCONDS.*****	Ď	
<b></b>	KK#KKC1	U	
	PXA TKK<#XA \$PYA TKK < #Y A \$P Z A TKK < #Z A	Ŋ	51
	PX0'&KK<#XU\$PYD'&KK<#YD\$PZB'\KK<#ZB	Q	52
^	TAB %KK<#TM\$DAB %KK<#D	n	53
С	PRINT 12,KPSS+IM:XA:YA:ZA:XB:YB:ZB:D:PHI IF #KFLAG:LQ:1< GO TO 2	D D	54 55
_c_	IF A MAS REACHED BASE OF CLOUDS, ELAG THIS POSITION.		5.6
	1F %ZA.LT.CLD8*100.< GO 10 3	1)	57
2	CONTINUE	Ď	58
_	KPSS#KPSSG1	p	59
	IF *KPSS.G1.100< GU 10 4	O	60
C	IF SLANT RANGE IS LESS THAN 501 UNITS, STUP. ****	1)	61
۵.		. D	
	11- TD.LT.501.0< GO 10 4	ŋ	63
	JIM#JIMGJDL1\$1M#JIM\$1M#1M/100.0	Ü	64
	IF %IM.GT.9.O< GO TO 4 - YXA#VA*P\$YYA#VA>Q\$VZA#YA*R	n O	65 66
	XA#XAEVXA+DT\$YA#YAEVYA*DT\$7A#ZAEVZA*DT	D.	66 67
	XD#XBGYXB*DT\$YB#YBGYYB*DT\$ZB#ZB	Ö	6.8
	D#0.0	ō	69
	ARG#\$XB-XA<**2&\$YB-YA<**2&\$ZB-ZA<**2	Ď	70
	IF WARG.GI.SHLC DWSQRTWARGC	D	71
	60 10 1	Ö	7.2
3	LIMBRKM<#KK-1	D	7 3
-	KELAGHI.	1)	14
	GO TO 2	()	75

Table D-4. Listing of Subroutines (Cont'd).

	* * * * * * * * * * * * * * * * * * *		_
4	IF TLIMATKHC.LE.IC LIMATKHC#KK	0	76
	IF %LIMB%KM<.LE.I< LIMB%KM<#KK .SCL#O.O1	Ŋ	77
С	SCALE THE POSITION VALUES. ***	0	78
·	DO 5 K#1.KK		_79 80
*****	PXATK<#PXATK<+SCL\$PYATK<#PYATK<*SCL	u	81
	PZAKK<#PZAKK<*SCL*PXBKK<#PXBKK<*SCL	ü	82
	PYBXK<#PYBSK<+SCL\$PZBXK<#PZBXK<+SCL	Ď	83
	DAB&K <ndab&k<+sci.< td=""><td>-</td><td>84</td></ndab&k<+sci.<>	-	84
5	CONTINUE	Ď	
-	RETURN		
	LNTRY HUNT	υ	87
C	THIS ENTRY DETERMINES THE POSITIONS OF THE TWO VEHICLES WHEN A	D	88
C	ALWAYS HEADS TOWARD THE CURRENT POSITION OF 6. ***	p	89
,C	PRINT 13.AZA.AZ8.EL.D1.Z81	I)	90
	CLDB#BCLD	0	91
	A#CDR+AZB\$VXB#CDS%A<+VB\$VYB#S1N%A<+VB	D	92
	A#CDR*AZA\$E#CDR*EL	0	93
	XALMDI+COSXEC4CUSXAC		94
	YAT#D1*COSEC+STNEAC	0	95
	ZAI#DI+SINXE<		96
	XANXAISYANYAISZANZAI		97
	XB#XBI\$YB#YBI\$ZG#ZBI\$D#DI	D.	
	KPSS#O	D	
-	TM#0.0		101
	JTM#0\$JDL1#20		102
	DINJDLT/100.0		103
	KK#O		104
С	DUCKET	- 15	
	KELAGNLELAGNO.	-n	106.
C	ESTABLISH THE BOUNDS WITHIN WHICH STATISTICS WILL BE COLLECTED. **	Ð	107
	UPPER#EL&5.		108
	LOWER#EL-5.	υ	109
	KM#KL/5061	D	110
6	CONTINUE	0	111
_, <b>C</b>	DETERMINE THE PUSITIONS OF A AND B. ***		1.1.2
	KK#KK&1	0	113
	PXATKKCHXASPYATKKCHYASPZATKKCHZA	_	114
	PXB TKK<#XB\$PYB TKK<#YB\$PZBTKK<#ZB	-	115
	TAB %KK<#TH\$DAB%KK<#D		116
	IF TKFLAG.EQ.1< GO TO 7		117
-C	THE A HAS REACHED THE BASE OF THE CLOUDS, BLAG THIS POSITION. AND		118
7	TH #ZA.LT.CLOB*100.< GO TO 8		119
ć	CONTINUE		120 121
· ·	PRINT 12,KPSS,TM,XA,YA,ZA,XB,YB,ZB,D,PH1 KPSS#KPSS&1		
r	IF THE SLANT RANGE DISTANCE IS LESS THAN 501 UNITS, OR IF THE		122
C	SIMULATED TIME HAS EXCHEDED 9 SECONDS. SIMP. 341		124
-	1F \$KPSS-61.90< GU 10 9		125
	11 *D.11.501.0< GO TO 9		126
	O.OOJ\NIWHTAMTUWHI&TJOUBHIUWHIU		137
	11 K1M.GT.9.05 GO TO 9		128
	P##XB~XA <td></td> <td>130</td>		130
	VXA#VA*P\$VYA#VA*Q\$VZA&VA*R		l lu
	XX#XX&VXX+D1\$YX#YX&VYX+D1\$ZX#ZX&VZX+D1	()	131
	XBN XBEV XB+DT \$YBW YBEV YB+OT \$ZBN ZB	l)	142

19

20

21 F

\_22 F 23

L 24 F 25

E 26

Ē

RETURN

KNT#Q

K#Ü

ENTRY FREE

JFLG#KFLG#0

END OF INITIALIZE. \*\*\*

\_ CLUB#BCLD#CLOT#TCLD

CR#RAD#CZ#2.\*CR

C

たいこう とういうがく あんじゃ こうじ くさいしょ かつと おとめの 教育を見る ないない はない はない はない はない とうじょう かっせい こうさいかん あまいかん (人のからな)

Table D-4. Listing of Subroutines (Cont'd).

С	DETERMINE THE CURRENT ELEVATION ANGLE. ***	0 13	33
	D#0.0	.D 13	34
	ARG##XB-XA<**26#YB-YA<**26%ZB-ZA<**2	0 13	35
	IE TARG GT SML< DESCRITARGS	-0-13	-
	PHIWATAN2%R, SQRT%P*+2EQ*+2<<	D 13	
	.PHI#-PHI+CRU	.D13	_
	IF %LFLAG.EQ.1< GO TO 6	0 13	
	IF THE ELEVATION ANGLE HAS EXCEEDED THE ANGULAR LIMITS ESTABLISHED		
	FLAG THIS POSITION. ***	0 14	-
	IE_TPHI_LI_UPPER_A.PHI_GT_LOHER<_GO_TO_6	_D_14	
	LIMAXKM<#KK	0 14	
	LFLAG#1	D 14	
	GU TU 6	D 14	
ļ	LIMB\$KM<#KK-1	D 14	
	KFLAG#1	D 14	
		. D. 14	
	IF TLIMATKH<.LE.1< LIMATKH<#KK	D 14	
	TE ZLIMDZKMC.LE.1C LIMDZKMC#KK	_0_15	
	SCALE THE POSITION VALUES. ***	0 15	
	SCL#0.01	.0 .1.5	
	DU 10 KW1,KK	0 15	
-	PXATK<#PXATK<*SCL \$PYATK<#PYATK<*SCL	.0. 15	
	PZARK<#PZARK<*SCL \$PXBRK<#PXBRK<*SCL	0 15	
	PYB \$K<#PYB \$K<*SCL\$PZB\$K<#PZB\$K<*SCL DAB\$K<#DAB\$K<*SCL	_0_15	
Q		0 15	
Ų	CONTINUE Return	0 15	
	RETURN	0 15	
		D 16	
	END	D 16	_
-			
	SUBROUTINE FREEF	E	J
	THIS SUBROUTINE USES THE POSITIONAL INFORMATION PRODUCED IN ELIHLR	E	2
:	HUNT OR HUNTO AND THE CLOUD INFORMATION GENERATED BY EITHER CLONO	E.	3
	OR CLOOVE TO DETERMINE THE HISTORY OF THE CELOS BETHEEN A AND B	<u>Ę</u>	
	CUMMON /BLK1/ XCLU%1000<,YCLD%1000<,JJ	Ē	•
	COMMON /BLK2/ PXAT100<,PYAT100<,PZAT100<,PXBT100<,PYBT100<,PZBT100	E	(
	1<,TAB*100<,DAB*100<,KK	Ŀ Ŀ	3
	COMMON /BLK4/ KLN\$200<,KL,LIMA\$4<,LIMB\$4<	E	3
	COMMON /BLK5/ CLDB	Ę	
	COMMON /BLK6/ J		Ť
_	COMMON /BLK7/ BCLD.TCLD.PCVR.RAD.HOR	E	
C	INITIALIZE ***		12
	PY#3.1416\$CDR#PY/180.0\$CRD#1.0/CDR		13
	SML#0.00001		14
	CR#RAD\$CZ#Z.*CR	E	1 :
	CAN 11 H D		
	SMLH#0.01		'n
	KBLNK#1R	E	17
		E	1

Table D-4. Listing of Subroutines (Cont'd).

1	CONTINUE	E	27
	KNI#ANIGI	<u>.E.</u> .	28.
	JC#1	Ŀ	29
С.	***** SHIFT URIGIN TO AX, AY AND RUTATE AXES FOR BY#O ****	E	30
C	SLOPE#II/D ****	£	31
	KWX & 1	£	32
	11- CK.GT.KK< GU TO 17	ε	33
	AX#PXAXK<1AY#PYAXK<.sALVL#PZAXK<.		_34_
	BX#PXB\$K <sby#pyb\$k<\$blvl#pzb\$k<< td=""><td>Ε</td><td>35</td></sby#pyb\$k<\$blvl#pzb\$k<<>	Ε	35
	HARA-VA DARX-VX BY ZOBLKH+#58D++5<	E	36
	SGN#1.0511 %D.L1.0 <sgn#-1.0< td=""><td>E</td><td>37</td></sgn#-1.0<>	E	37
	IF TABS TO LIT SMLHC D#SGN*SMLH	E.	38
	SLP#H/D	E	39
	SLPZ#KBLVL-ALVL <td>Æ.</td> <td>40</td>	Æ.	40
	ANG# ATAN 2'CH, D< \$ DGR S # ANG * CRD	F	41
	LSNA ACOS ZANU CAF SNA #SIN ZANGC	£_	
C	******* RUTATION EQUATIONS ****	E	43
C	XP#	£	44
C	YP#\$Y-AY<*C\NA-&X-AX<*F\$NA	6	45
C	*****ne****** unaunutikunu kilekk	Æ	46
C	PRINT 26	E	47
	KN#KNI-1.	<u>E</u>	_48_
C	PRINT 25, KN, TABEKC, PXAKKC, PYAKKC, PZAKKC, PXBKKC, PYBKKC, PZBKKC, DABE	E	49
Ç	1K<,K	E	50
C	TEST FOR A AND B ABOVE UR BELOW CLOUD FIELD	E	51
	IF KALVLIGTICLOUK GO TO 2	Æ	52
_	IF BLVL.GT.CLOBC GO TO 2	E	53
<b>C.</b>	ALAND, BLARE BUTH BELOW CLOUDS.	<u> </u>	_54_
_	GO TO 11	E	55
2	CONT INUE	E	56
	IF WALVEL T. CLOT C GO TO 3	6	57
	If WBLVELLI-CLOYC GO TO 3	E	58
C	A AND B ARE BUTH ABOVE CLOUDS	E	59
_		E	_
3	CONTINUE	E	61
4	CONTINUE	Ŀ	62
	CX#XCLD&ACC*CA#ACCAACA	6	63
	TRM1#CY-AY\$1RM2#CX-AX	E	64
	X#TRM1*F SNAETRM2*C SNA	F	85
	LYATRMIYUSNA-TRHZ#FSNA		-66-
C	TEST FOR GLU BETHEEN A AND R	E	67
	IF &X.L1CR< GU TO 6	E	6.8
	TE TXUUT TRECR<< OU TO 6 CLOUD IS LUCATED BETWEEN A AND B	£ E	69
L (	*** TIST FOR A INSIDE CYL BASE	E	70
,			11
	RI#Q.Q		7.2
	ARGKXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX	£.	73
	1) FARG-GT-SMC RT#SURT#ARGC	ŧ	74
	IF GRILLIACK GU TO 12	ŀ	75
C	* JUST FOR B INSIDE CYL BASE	6	76
	X7#X+K\$Y7#Y\$R7#0.0	ָר ר	77
	ARGMATICAL CHI COLLABOREMADICA	.2. a	7.8
	TE WARG-GI-SMLK RIWSQRIWARGK TE WRI-LY-CRK GO 10 13	į. E	79
c	THE TRIBUTE CREATER THE TENT OF THE TRIBUTE THE TRIBUT	Į.	80
C		l,	81
	ABYMABSXY IF KABY.LI.CR< GD To 7	F.	82
5	LIGHT INUE	۲ ئا.	83 84
	J. 4.1.C.L	.5	85
	11 KJL.LT.JJ ( GO 10 4	Ĺ	86
	60° 10° 11		87
	** **	٠,	01

Table D-4. Listing of Subroutines (Cont'd).

6	CONT INUE	E 00
č	LOS NOT OBSCURED BY CURRENT CLOUD	_E 88. E 89
-	_60.10.5	E 90
7	CONT INUE	E 91
С	LOS INTERCEPT OF CLO PRICTN ON THE XY PLANE	€ 92
С	TEST FOR LOS CLD INTERCEPT ON THE ZX PLANE	E 93
С	PRINT 22,JC	E94
	STP#0.0\$ ARG#CR**2-Y**2	E 95
***	IF %ARG.GI.SML< SIP#SQRI%ARG<	E96_
	X1#X~STP\$X2#X&STP	E 97
	Z1#ALVLESLPZ*X1\$Z2#ALVLESLPZ*X2 CONTINUE	<u>E 98</u>
_	TEST EDD 71 AND 72 DOTH LESS THAN SED DASS	E 99
- Marine III	TEST FOR Z1 AND Z2 BOTH LESS THAN CLD BASE  IF \$Z1.GT.CLDB< G0 T0 9	E 101
	IF \$22.6T.CLDB< GO TO 9	E 101
č	Z1 AND ZZ ARE BOTH LESS THAN CLD BASE	E 103
•	GO TO 5	E 104
9	CONTINUE	F 105
.C	TEST FOR Z1 AND Z2 BOTH GREATER THAN CLOUD TOP. ***	E 106
	IF %Z1.LT.CLDT< GO TO 10	E 107
	IF \$72.LT.CLDI< GO TO 10	E_108_
С		
	21 AND 22 ARE BOTH GREATER THAN CLOUD TOP  GO TO 5	E_110_
10	CONTINUE	t 111
ك	LOS IS OBSCURED *** OBTAIN NEXT SET OF A AND B	
r	KLNSKLEK<#KBLNK PRINT 24.JC	E 113
	PRINT 24+JC GO TO 14	
11	CONTINUE	E 115
C	CLOUD FREE LINE OF SIGHT FOR CURRENT A AND B	E 117
	PRINT_23.JC	F 118
	GO TO 14	E 119
_12	CONTINUE	
С	PT A FALLS WITHIN CLD PRJTN ON THE XY PLANE	E 121
	PRINT 20.JC	E_122_
С	TEST FOR LOS CLD INTERCEPT ON THE ZX PLANE	E 123
***	ZIHALVL	<u>E 124</u>
	STP#0.0\$ARG#CR**2-Y**2	E 125
-	IE #ARG.GT. SML< STP#SQRT#ARG< X2#X6STP	
	ZZ#ALVL&SLPZ*XZ	E 127
	GO TO 8	E 129
_13.	CONTINUE	E 130
C	PT B FALLS WITHIN CLD PRJTN ON THE XY PLANE	E 131
Ç	PRINT 21, JC	. E 132
С	TEST FOR LOS CLD INTERCEPT ON THE ZX PLANE	E 133
	Z2#BLVL\$XP#X~R\$YP#Y	E 134
	STP#0.0\$ARG#CR**2-Y**2	E 135
-	IE *ARG.GT.SML< STP#SQRT*ARG<	
	B2#STP-XP	E 137
-	Z1#BLVL-SLPZ*B2	
14	GD TO 8 CONTINUE	E 139
X	IF %JFLG.GT.O< GO TO 15	E 141
		E 147
15		E 143
	LE *KELG.GT.OC GO TO 16	E. 144
	IF %DAB%K<.LT.5.1< GO TO 19	E 145
_16		E 146
	GU TO 1	E 147

Table D-4. List of Subroutines (Cont'd).

1.7	CONTINUE	~	
.1.(	CONTINUE Kløkl650	_	148
	KETURN.		149 150
18	CONTINUE	_	151
	JELG#1.		
	KLNKKLEK<#KX		152 153
	GO. 10. 15.	e e	156
19	CONTINUE		155
_	KELG#1	-	156
	KLN <b>x</b> KL&K<#KX		157
	GU TO. 16	-	158
C			159
<u>c_</u>	நாக மாள்ளத்தோள் நாக மாக மாக மாக மாக மாக மாக மாக மாக மாக ம	Ē	160
	END		101-
		-	
	SUBROUTINE MAPE	F	1
Ċ	THIS SHARPHITIME IS HERD TO COLLECT CEIDS STATISTICS	l li	,
G	THIS SUBROUTINE IS USED TO COLLECT CFLOS STATISTICS. ***  COMMON_XBLKT/_XCLD*1000<-YCLD*1000<-JJ	6	4
	COMMON /BLK2/ PXA#100<,PYA#100<,PZA#100<,PXB#100<,PYB#100<,PZB#100	F*	4
		Ė	
-	CUMMON /BLK3/ AZA,AZB,EL		6
	COMMON /BLK4/ KLN\$200C.KL.LIMA\$4C.LIMB\$4C		7
•	COMMON ZBUK6Z J	ç	il
	COMMON /BLK7/ BCLD. ICLD. PCVR. RAD. HOR	E	9
	COMMON /BLKB/ L.LTST.K.KLL%12.4<	ŀ	
	COMMON /BLKK/ KK1,KK2,KK3,KK4	F	
	DIMENSION KOUNT 12<	F	12
	KDSH#1R-	Ŀ	13
C	INITIALIZE ***	F-	14
	KBLNK#1R	LE.	_15_
	KX#1RX	F	16
<b>C</b>	END OF INITIALIZE. ***	Ŀ	
	RETURN	Ŀ	18
C	BLANK THE CFLOS STORAGE ARRAY AND RETURN THE ANGULAR AND	F	19
C	CLOUD BASE POSITION FLAGS TO ZERO. ***	F	20
-	ENIRY.CLR.	"£.	21
	KL#O	F	
	DO 1 I#1,200	۴	
	KINZI<#KBINK	F	_
1	CONT INUE	F	
_	DO 2 K#1,4	F	
-2.			_27.
	RETURN	Ŀ	28
r	ENTRY CLRX HILL THE CELOS STORAGE FLEED WITH DASHES. INSERT AN X PRINT AT	F	29 30
C	THE END OF THE FIELD. ***	Ę	31
L	DU 3 1#1+KK	F.	32
	KLN¥KLG I.C#KUSH.	<b>.</b> E	ĹĹ
3	CONT INUF	.i.	34
J	K#XLEKK61	F	35
	KLNXKC#KX	þ	16
	RETURN	F	31
	ENTRY GILO	· •	38
C.	ZERO THE CHLOS TOTAL-HITS FIFLD. ***	Į.	39
•	00 4 141,12	F.	40
4	KKNNTKL <#O	F	41
*	RETURN	ì	43
	ENTRY GILL	I	43
	- · · · · · · · - ·		

## Table D-4. List of Subroutines (Cont'd).

С	COLLECT THE CFLOS STATISTICS. ***	F	44
	ONATAMO LWJ	۶ ۴	45.
	DO 6 K#1.2		47_
	LTST#O	F	48
	KL#4K-1<+50	F	4.9 50
	DO 6 1#1,KK KISI#KLN\$16KL<	f	51.
	IF TKTST.NE.KBLNK< GO TO 5	F	52
	LISINO		_53
Ç	GO TO 6	F	54 66
Č	COLLECT TIME-RELATED CFLOS STATISTICS. KNTA IS USED TO COLLECT INSTANTANEOUS HITS. LIST IS USED FOR TIME-RELATED VALUES. ***	Ŀ	56
5	KNTA#KNTAG1	F	57
	LTST#LTSTG1		58
6	IF *LIST-GE-54 CALL CATCH2 CONTINUE	F F	.59.
0	KOUNT THOSE	Ę	60 61
	RETURN	F	62
_	ENTRY GIL2	F	63
С	GATHER INSTANTANEOUS CFLOS STATISTICS. ***		64 <u>65</u> .
	LSUM#Q KSUM#KK	_E	_0.2
	DO 7 L#1.12	F	67
7	L SUM#L SUMGKOUNT &L <	F	68
	STATK#%LSUM+1.0 %KSUM+24.<<br PRINT 8. STATK	F	69 70
C	GATHER THE LIME-RELATED CFLOS STATISTICS. ***	.E.	71
	CALL GILCAT3	Ŀ	72
r	RETURN		73
C		٤	74 75
č		F	76
8	EORMAI 3/-10X-21HPROBABILITY OF A CILUS - STALLC CASEE9-34		
	END	F	78-
	SUBROUTING CATCH	G	1
C	THIS SUBROUTINE IS DESIGNED TO GATHER THE TIME-RELATED CFLOS	Ğ	Ž
C_	STATISTICS . ***	G.	3
	COMMON /BLK3/ AZA,AZB,FL,XB1,YB1,ZB1,D1,VA,VB COMMON /BLK7/ BCLD,TCLD,PCVR,RAD,HDR	G G	4
	COMMON /BLKB/ L.LISI.K.KLLX12.4<	G	6
	CUMMON /BLK2/ PXAX10Q<,PYAX10U<,PZAX10U<,PXBX10Q<,PYBX10Q<,PZEX1QQ	G	7
	14, TABELOOK, DARELOOK, KK	G	8
	.DIMENSION.05%12.4<. D10%12.4<. D15%12.4<. D20%12.4<. D25%12.4<. D3 10%12.4<. D35%12.4<. D40%12.4<. D45%12.4<. F5%4<. F10%4<. F15%4<. F	D. G	10
	220844, F25844, F30844, L5812,44, L10812,44, L15812,44, L20812,44,	Ğ	ii
	1625812,44, 630812,44, 635812,44, 640812,44, 645812,44	G	15
	RETURN Entry Catchi	Ĝ	13
С	ZERO THE INDICATED ARRAYS. ***	G	14 15.
_	DC-1 K#1,4	G	16
	F5KKKMF1OKKKMF15KKKMF2OKKKMF25KKKMF3OKKKMO.U	G	17
	DO 1 J#1,12 D5\$J,K<#D1G\$J,K<#D15\$J,K<#D2G\$J,K<#D25\$J,K<#D3G\$J,K<#D35\$J,K<#D35\$J,K<#D35\$J,K<#D4G\$	(i	18
	1.7*K<\\$04\27*Y<\\$0.0	G	19
	LSX.L. N. C. R. C. R. C. R. C.	G	21
	1 1, 10 4 1 4 5 2 1 4 1 4 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1	G	2.2

Table D-4. List of Subroutines (Cont'd).

1_	CUNI INUE	G23.
	RETURN	G 24
	ENTRY CATCH2	G 25
	IF %LTS1.EQ.5< L5%L.K<#1	G 26
	D5%L,K<#D5%L,K<&1	G 27
	IF \$LIST.LI.10< GO TO 2	G 28
	IE XLTST.EQ.104.L10XL.KC#1.	C29.
	D10%L,K<#D10%L,K<&1	G 30
	1F #LTST.LT.15< GU 10 2	6 31
	IF %LTST.EQ.15< L157L.K<#1	G 32
	D15%L,K<#015%L,K<&1	G 33
	IF *LTST.LT.20< GO TO 2	6 34
	1E_XLIST.EO.20< L20XL,K<#1.	
	D20%L*K<#D20%L*K<61	G 36
	1F %LTST.LT.25< GO TO 2	G 37
	IF %LTST.EQ.25< L25%L,K<#1	G 38
	D25%L+K<#U25%L+K<&1	6 39
	IF %LTST-LT-30< GO TO 2	6 40
	₩30%L <sub>*</sub> K<#D30%L <sub>*</sub> K<&1	G 42
	1F %LTSf.LT.35< GO TO 2	G 43
	IF %LTST.=EQ.35< L35%L,K<#1	6 44
	N35%L,K<#U35%L,K<&1	G 45
	IF %LTST-LT-40< GU TO 2	G 46
~~	1E 3,LTSTEQ. 404. L408L-K4EL.	
	)40%L,K<#()40%L,K<61	G 48
	21 \$LTST-11-45< GO TO 2	G 49
	1F %LTST.EQ.45< L45%L,K<#1	G 50
	D45 \$L, K<#D45 \$L, K<&1	G 51
2	CUNTINUE	G 52
_	- RETURN.	
	ENTRY GILCAT3	G 54
C	GATHER STATISTICS ON ONE-SECOND AND TWO-SECOND LONG CFLOS	8 55
С	PROBABILITIES. ***	G 56
	K5#K10#0 .	G 57
	M5#KK-4	6 58
	M1Q#KK±3	
	00 3 J#1+12	G 60
	DU 3 K#1,2	G 61
	K5#K5@D5%J,K<	G 62
	K10#K10&D10#J,K<	G 63
3	CUN7 INUE	G 64
	S5#\$K5\1.0 \$24.*\15C</td <td></td>	
	\$10#\$K10+1.0 \$24.*M10<</td <td>G 66</td>	G 66
	PRINT 6	G 67
	PRINT 7, \$5,510	G 68
	LL5#LL10#0	6 69
	00 5 K#1+2	G 70
1	a company of the contract of t	G7.1
4	1#161	G 72
1	IF \$1.6T.12< GO TO 5	G 73
	LL5#LL5&L5%I,K<	G 74
	LL10#LL10EL10\$1,K<	G 75
	GR TO 4	6 76

Table D-4. List of Subroutines (Cont'd).

5	CUNTINUE PRINT 8 PRINT 9: LL5.LL10	.G. G	7.1. 78 79
	RETURN	G	80
Ç		, C	.81.
С		G	82
Ç		G.	.83.
6	FORMAT \$10%,54HPROBABILITY OF A CFLOS FOR AT LEAST THE TIME INDICA	G	84
	11ED<	<u> </u>	85
7	FORMAT %10X,5H.GE.1,F8.3,10X,5H.GE.2,F8.3<	G	86
8	FORMAT \$10x,74HMINIMUM FREQUENCY OF OCCURRENCE OF A CFLOS FOR AT L	Ģ	.87
	LEAST THE TIME INDICATEDS	G	88
9.	FURMAT \$9X.10HONE SECOND.19.3H/24.9X.11HTWO SECONDS.19.3H/24<	.G	89
	END	G	90-

## LIST OF TECHNICAL NOTES

Number	<u>Title</u>	<u>Date</u>
74-1	Atmospheric Moisture Parameterization (AD-784814)	Jan 74
74-2	Development of a Gridded Data Base ( ) (Publication delayed)	Apr 74
74-3	A Precipitating Convective Cloud Model (ADA-002117)	May 74
74-4	A Synoptic-Scale Model for Simulating Condensed Atmospheric Moisture (ADA-002118)	Jun 74
75-1	Estimated Improvement in Forecasts of the SANBAR Hurricane Model Using the Airborne Weather Reconnaissance System (ADA-004097)	Jan 75
75-2	Spring Weather Patterns of the Western United States (Reprints) (ADA-006691)	Mar 75
75-3	Summer Weather Patterns of the Western United States (Reprints) (ADA-009860)	May 75
75-4	Autumn Weather Patterns of the Western United States (Reprints) (ADA-013801)	Jul 75
75-6	Winter Weather Patterns of the Western United States (Reprints) (Publication delayed)	Sep 75
76-1	Listing of Seminars Available at Hq AWS, AWS Wings, and AFGWC (Publication delayed)	
76-2	Some Aspects of Estimating the Probability of Cloud-Free Lines-of-Sight in Dynamic Situations (	Mar 76